Modicon M251 Distributed PAC

User Guide

EIO0000004089.05
12/2023

www.se.com

Legal Information

The information provided in this document contains general descriptions, technical characteristics and/or recommendations related to products/solutions.

This document is not intended as a substitute for a detailed study or operational and site-specific development or schematic plan. It is not to be used for determining suitability or reliability of the products/solutions for specific user applications. It is the duty of any such user to perform or have any professional expert of its choice (integrator, specifier or the like) perform the appropriate and comprehensive risk analysis, evaluation and testing of the products/solutions with respect to the relevant specific application or use thereof.

The Schneider Electric brand and any trademarks of Schneider Electric SE and its subsidiaries referred to in this document are the property of Schneider Electric SE or its subsidiaries. All other brands may be trademarks of their respective owner.

Schneider Electric does not grant any right or license for commercial use of the document or its content, except for a non-exclusive and personal license to consult it on an "as is" basis.

Schneider Electric reserves the right to make changes or updates with respect to or in the content of this document or the format thereof, at any time without notice.

To the extent permitted by applicable law, no responsibility or liability is assumed by Schneider Electric and its subsidiaries for any errors or omissions in the informational content of this document, as well as any non-intended use or misuse of the content thereof.

Table of Contents

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.

Qualification of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product.

The qualified person must be able to detect possible hazards that may arise from parameterization, modifying parameter values and generally from mechanical, electrical, or electronic equipment. The qualified person must be familiar with the standards, provisions, and regulations for the prevention of industrial accidents, which they must observe when designing and implementing the system.

Intended Use

The products described or affected by this document, together with software, accessories, and options, are controllers intended for industrial use according to the instructions, directions, examples, and safety information contained in the present document and other supporting documentation.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements, and the technical data.

Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety-related measures must be implemented.

Since the product is used as a component in an overall machine or process, you must ensure the safety of persons by means of the design of this overall system.

Operate the product only with the specified cables and accessories. Use only genuine accessories and spare parts.

Any use other than the use explicitly permitted is prohibited and can result in unanticipated hazards.

About the Book

Document Scope

Use this document to:

- Install and operate your M251 distributed PAC (Programmable Automation Controller).
- Connect the M251 distributed PAC to a programming device equipped with EcoStruxure Automation Expert software.
- Interface the M251 distributed PAC with I/O expansion modules, HMI and other devices.
- Familiarize yourself with the M251 distributed PAC features.

  NOTE: Read and understand this document and all related documents before installing, operating, or maintaining your controller.

Validity Note

This document has been updated for the release of EcoStruxure™ Automation Expert V23.1.

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

The characteristics of the products described in this document are intended to match the characteristics that are available on www.se.com. As part of our corporate strategy for constant improvement, we may revise the content over time to enhance clarity and accuracy. If you see a difference between the characteristics in this document and the characteristics on www.se.com, consider www.se.com to contain the latest information.

Available Languages of this Document

This document is available in these languages:

- English (EIO0000004089)
- French (EIO0000004503)
- German (EIO0000004504)
- Spanish (EIO0000004505)
- Italian (EIO0000004506)
- Chinese (EIO0000004507)
- Portuguese (EIO0000004508)
- Turkish (EIO0000004883)

Related Documents

Title of Documentation	Reference Number
Modicon TM3 Digital I/O Modules - Hardware Guide	EIO0000003125 (ENG) EIO0000003126 (FRE) EIO0000003127 (GER) EIO0000003128 (SPA) EIO0000003129 (ITA) EIO0000003130 (CHS) EIO0000003424 (POR) EIO0000003425 (TUR)
Modicon TM3 Analog I/O Modules - Hardware Guide	EIO0000003131 (ENG) EIO0000003132 (FRE) EIO0000003133 (GER) EIO0000003134 (SPA) EIO0000003135 (ITA) EIO0000003136 (CHS) EIO0000003426 (POR) EIO0000003427 (TUR)
Modicon TM3 Expert I/O Modules - Hardware Guide	EIO0000003137 (ENG) EIO0000003138 (FRE) EIO0000003139 (GER) EIO0000003140 (SPA) EIO0000003141 (ITA) EIO0000003142 (CHS) EIO0000003428 (POR) EIO0000003429 (TUR)
Modicon TM3 Transmitter and Receiver Modules - Hardware Guide	EIO0000003143 (ENG) EIO0000003144 (FRE) EIO0000003145 (GER) EIO0000003146 (SPA) EIO0000003147 (ITA) EIO0000003148 (CHS) EIO0000003430 (POR) EIO0000003431 (TUR)
Modicon TM3 Safety Modules - Hardware Guide	EIO0000003353 (ENG) EIO0000003354 (FRE) EIO0000003355 (GER) EIO0000003356 (SPA) EIO0000003357 (ITA) EIO0000003358 (CHS) EIO0000003359 (POR) EIO0000003360 (TUR)

Title of Documentation	Reference Number
Modicon TM4 Expansion Modules - Hardware Guide	EIO0000003155 (ENG) EIO0000003156 (FRE) EIO0000003157 (GER) EIO0000003158 (SPA) EIO0000003159 (ITA) EIO0000003160 (CHS)
TM251MDESE - Instruction Sheet	GDE74308

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

Product Related Information

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

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

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

⚠DANGER

POTENTIAL FOR EXPLOSION

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

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

⚠WARNING

LOSS OF CONTROL

- 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. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2021	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.

M251 Distributed PAC General Hardware Overview

Overview

This chapter provides general information about the M251 distributed PAC system architecture and its components.

M251 Distributed PAC Description

Overview

The Modicon M251 Distributed PAC is a dual-channel controller that supports Ethernet communication. It is expandable with TM3 I/O modules. The Modicon M251 Distributed PAC is configured and programmed with the EcoStruxure Automation Expert software.

Power Supply

The M251 distributed PAC is powered by 24 Vdc, page 47.

Real Time Clock

The M251 distributed PAC includes a Real Time Clock (RTC) system, page 30.

Run/Stop

The M251 distributed PAC can be stopped externally by the following:

- A hardware RUN/STOP switch, page 30
- An EcoStruxure Automation Expert software command

Memory

This table describes the different types of memory:

Memory Type	Size	Used
RAM	64 Mbytes	To execute the application.
Nonvolatile	128 Mbytes	To save the program and data in case of a power interruption.

Removable Storage

The M251 distributed PAC includes an embedded SD card slot, page 59.

Embedded Communication Features

The M251 distributed PAC native communication ports include:

- Dual port Ethernet switch, page 51
- Ethernet port for fieldbus, page 51
- USB mini-B port, page 53. Power only.
- Serial line port, page 53

Expansion Modules

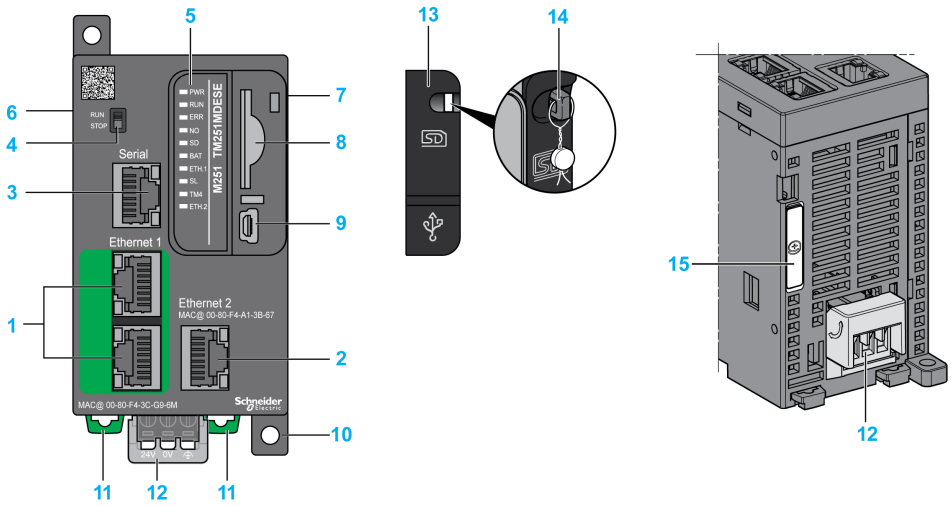
The M251 distributed PAC supports the following modules:

- TM3 expansion modules, page 19
- TM4 expansion modules, page 27

TM251MDESE Presentation

Description

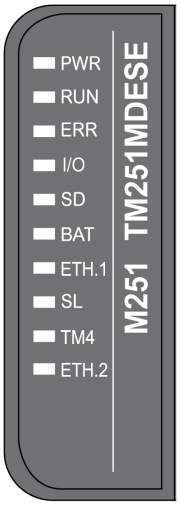
This figure shows the different components of the TM251MDESE controller:



N°	Description	Refer to
1	Dual port Ethernet switch	Ethernet Port, page 51
2	Ethernet port 2	Ethernet Port, page 51
3	Serial line port / Type RJ45	Serial Line Port, page 53
4	RUN/STOP switch	RUN/STOP, page 30
5	Status LEDs	–
6	TM4 bus connector	TM4 Expansion Modules, page 27
7	TM3 bus connector	TM3 Expansion Modules, page 19
8	SD card slot	SD Card, page 59
9	USB mini-B port (Power only)	USB Mini-B Port , page 53
10	Surface mounting lugs	–
11	Clip-on lock for 35 mm (1.38 in.) top hat section rail (DIN-rail)	Top Hat Section Rail, page 40
12	24 Vdc power supply	DC Power supply Characteristics and Wiring, page 47
13	Protective cover (SD card slot and USB mini-B port)	–
14	Locking hook (Lock not included)	–
15	Battery holder	Real Time Clock (RTC), page 30

Status LEDs

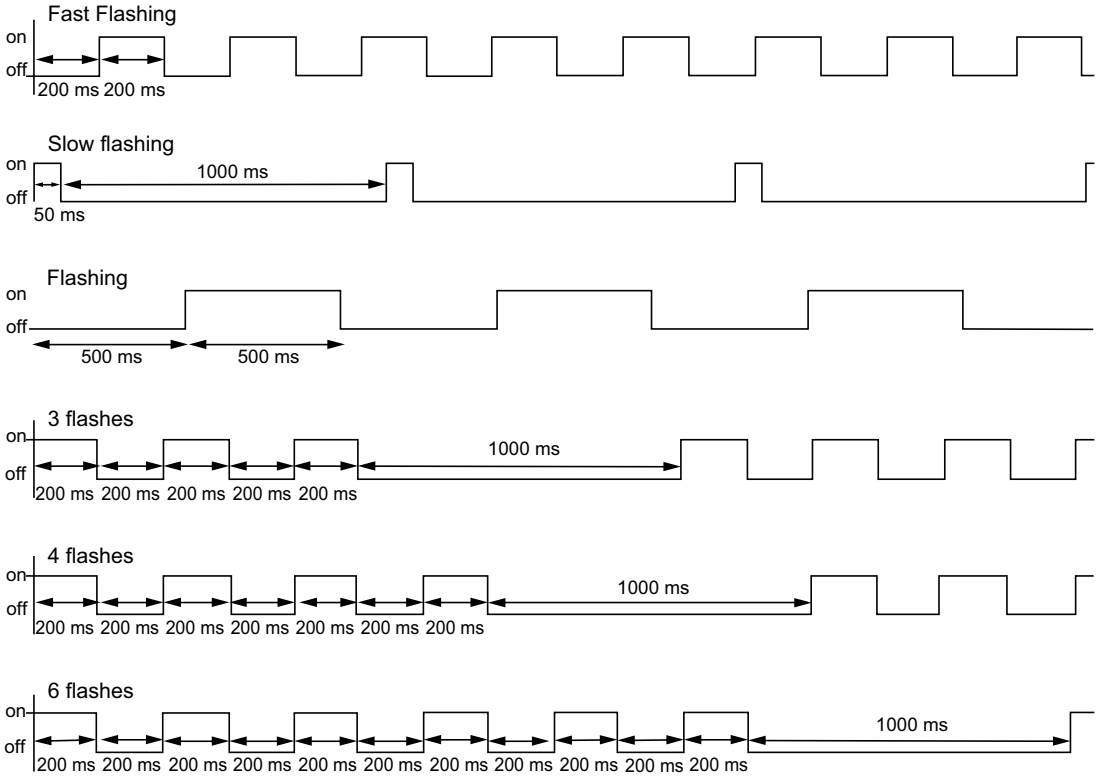
This figure shows the status LEDs:



The following table describes the system status LEDs:

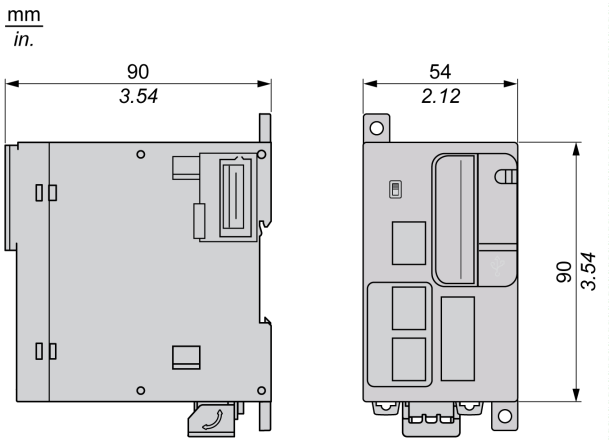
Label	Function Type	Color	Status	Run-time State	Description
PWR	Power	Green	On	–	Power is applied.
			Off	–	Power is removed.
RUN	Machine status	Green	On	STARTED	The controller is running a valid application.
			Fast flashing	STOPPED	The controller has a valid application that is stopped.
			Slow flashing	CLEANED	The controller has no application.
			Off	–	Cyber security configuration required. The default password must be changed.
ERR	Internal Error	Red	On	HALTED	An application error has been detected. See **Fetch Log Files > Log Files** in the EcoStruxure Automation Expert software.
			Fast flashing	CLEANED	• If RUN LED is ON: A system error has been detected. • If RUN LED is OFF: A firmware error has been detected. See **Fetch Log Files > Log Files** in the EcoStruxure Automation Expert software.
I/O	I/O error	Red	On	–	Device errors detected on TM3 bus or SD card.
SD	SD card	Green	On	–	The script is being executed.
BAT	Battery	Red	On	–	The battery needs to be replaced.
			Flashing	–	The battery charge is low.
ETH.1 **ETH.2**	Ethernet port status	Green	On	–	The Ethernet port is connected and the IP address is defined.
			3 flashes	–	The Ethernet port is not connected.
			4 flashes	–	The IP address is already in use.
			6 flashes	–	The configured IP address is not valid.
SL	Serial line	Green	Flashing	–	The serial line is active.
			Off	–	No serial communication.
TM4	–	–	–	–	Reserved.

This figure shows the types of flashing of the status LEDs:



Dimensions

The following diagram shows the dimensions of the TM251MDESE controller:



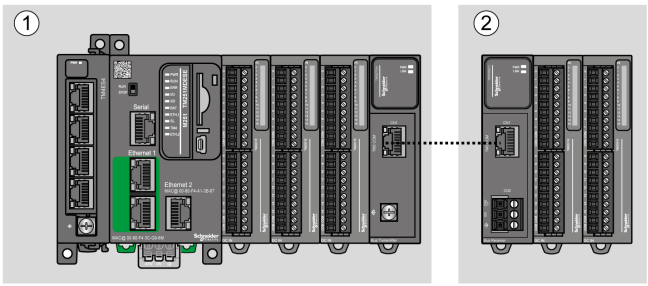
Maximum Hardware Configuration

Introduction

The M251 distributed PAC is a control system that offers a scalable solution with optimized configurations and an expandable architecture.

Local and Remote Configuration Principle

The following figure defines the local and remote configurations:



(1) Local configuration

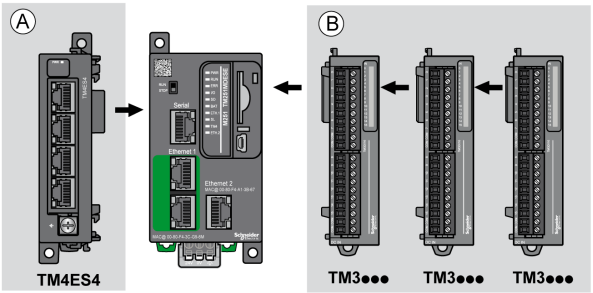
(2) Remote configuration

M251 Distributed PAC Local Configuration Architecture

Optimized local configuration and flexibility are provided by the association of:

- M251 distributed PAC
- TM3 expansion modules
- TM4 expansion modules (TM4ES4 only)

The following figure represents the components of a local configuration:



(A) Expansion modules (3 maximum)

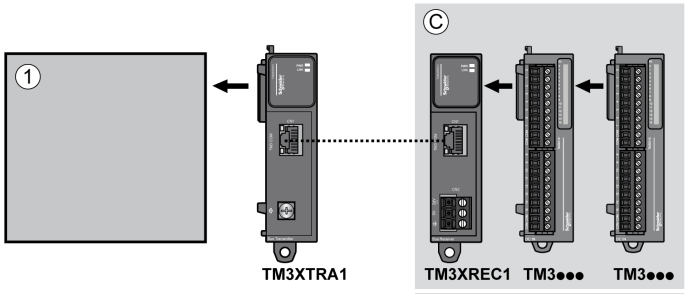
(B) Expansion modules (7 maximum)

M251 Distributed PAC Remote Configuration Architecture

Optimized remote configuration and flexibility are provided by the association of:

- M251 distributed PAC
- TM3 expansion modules
- TM3 transmitter and receiver modules

The following figure represents the components of a remote configuration:



(1) Controller and modules

(C) TM3 expansion modules (7 maximum)

Maximum Number of Modules

The following table shows the maximum configuration supported:

References	Maximum	Type of Configuration
TM251MDESE	7 TM3 expansion modules	Local
	3 TM4ES4 expansion modules	Local
TM3XTRA1/TM3XREC1	7 TM3 expansion modules	Remote
NOTE: TM3 transmitter and receiver modules are not included in a count of the maximum number of expansion modules.		

NOTE: The configuration with its TM3 expansion modules is validated by EcoStruxure Automation Expert software in the **Configuration** window.

NOTE: In some environments, the maximum configuration populated by high consumption modules, coupled with the maximum distance allowable between the TM3 transmitter and receiver modules, may present bus communication issues although the EcoStruxure Automation Expert software allows for the configuration. In such a case you will need to analyze the power consumption of the modules chosen for your configuration, as well as the minimum cable distance required by your application, and possibly seek to optimize your choices.

TM3 Expansion Modules

Introduction

The range of TM3 expansion modules includes:

- Digital modules, classified as follows:
  - Input modules, page 19
  - Output modules, page 20
  - Mixed input/output modules, page 21
- Analog modules, classified as follows:
  - Input modules, page 22
  - Output modules, page 23
  - Mixed input/output modules, page 24
- Expert modules, page 25
- Transmitter and receiver modules, page 25
- Safety modules, page 26

For more information, refer to the following documents:

- TM3 Digital I/O Modules Hardware Guide
- TM3 Analog I/O Modules Hardware Guide
- TM3 Expert Modules Hardware Guide
- TM3 Transmitter and Receiver Modules Hardware Guide
- TM3 Safety Modules Hardware Guide

TM3 Digital Input Modules

The following table shows the TM3 digital input expansion modules, with corresponding channel type, nominal voltage/current, and terminal type:

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

TM3 Digital Output Modules

The following table shows the TM3 digital output expansion modules, with corresponding channel type, nominal voltage/current, and terminal type:

Reference	Channels	Channel Type	Voltage Current	Terminal Type / Pitch
TM3DQ8R	8	Relay outputs	24 Vdc / 240 Vac 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 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 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 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 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 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 8 A maximum per common line / 2 A maximum per output	Removable screw terminal blocks / 3.81 mm
TM3DQ16RG	16	Relay outputs	24 Vdc / 240 Vac 8 A maximum per common line / 2 A maximum per output	Removable spring terminal blocks / 3.81 mm
TM3DQ16T	16	Regular transistor outputs (source)	24 Vdc 8 A maximum per common line / 0.5 A maximum per output	Removable screw terminal blocks / 3.81 mm
TM3DQ16TG	16	Regular transistor outputs (source)	24 Vdc 8 A maximum per common line / 0.5 A maximum per output	Removable spring terminal blocks / 3.81 mm
TM3DQ16TK	16	Regular transistor outputs (source)	24 Vdc 2 A maximum per common line / 0.1 A maximum per output	HE10 (MIL 20) connector
TM3DQ16U	16	Regular transistor outputs (sink)	24 Vdc 8 A maximum per common line / 0.5 A maximum per output	Removable screw terminal blocks / 3.81 mm

Reference	Channels	Channel Type	Voltage Current	Terminal Type / Pitch
TM3DQ16UG	16	Regular transistor outputs (sink)	24 Vdc 8 A maximum per common line / 0.5 A maximum per output	Removable spring terminal blocks / 3.81 mm
TM3DQ16UK	16	Regular transistor outputs (sink)	24 Vdc 2 A maximum per common line / 0.1 A maximum per output	HE10 (MIL 20) connector
TM3DQ32TK	32	Regular transistor outputs (source)	24 Vdc 2 A maximum per common line / 0.1 A maximum per output	HE10 (MIL 20) connectors
TM3DQ32UK	32	Regular transistor outputs (sink)	24 Vdc 2 A maximum per common line / 0.1 A maximum per output	HE10 (MIL 20) connectors

TM3 Digital Mixed Input/Output Modules

This following table shows the TM3 mixed I/O modules, with corresponding channel type, nominal voltage/current, and terminal type:

Reference	Channels	Channel Type	Voltage Current	Terminal Type / Pitch
TM3DM8R	4	Regular inputs	24 Vdc 7 mA	Removable screw terminal blocks / 5.08 mm
	4	Relay outputs	24 Vdc / 240 Vac 7 A maximum per common line / 2 A maximum per output	
TM3DM8RG	4	Regular inputs	24 Vdc 7 mA	Removable spring terminal blocks / 5.08 mm
	4	Relay outputs	24 Vdc / 240 Vac 7 A maximum per common line / 2 A maximum per output	
TM3DM24R	16	Regular inputs	24 Vdc 7 mA	Removable screw terminal blocks / 3.81 mm
	8	Relay outputs	24 Vdc / 240 Vac 7 A maximum per common line / 2 A maximum per output	
TM3DM24RG	16	Regular inputs	24 Vdc 7 mA	Removable spring terminal blocks / 3.81 mm
	8	Relay outputs	24 Vdc / 240 Vac 7 A maximum per common line / 2 A maximum per output	

TM3 Analog Input Modules

The following table shows the TM3 analog input expansion modules, with corresponding resolution, channel type, nominal voltage/current, and terminal type:

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

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

TM3 Analog Output Modules

The following table shows the TM3 analog output modules, with corresponding resolution, channel type, nominal voltage/current, and terminal type:

Reference	Resolution	Channels	Channel Type	Mode	Terminal Type / Pitch
TM3AQ2	12 bit, or 11 bit + sign	2	outputs	0...10 Vdc -10…+10 Vdc 0...20 mA 4...20 mA	Removable screw terminal block / 5.08 mm
TM3AQ2G	12 bit, or 11 bit + sign	2	outputs	0...10 Vdc -10…+10 Vdc 0...20 mA 4...20 mA	Removable spring terminal block / 5.08 mm
TM3AQ4	12 bit, or 11 bit + sign	4	outputs	0...10 Vdc -10…+10 Vdc 0...20 mA 4...20 mA	Removable screw terminal block / 5.08 mm
TM3AQ4G	12 bit, or 11 bit + sign	4	outputs	0...10 Vdc -10…+10 Vdc 0...20 mA 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 resolution, channel type, nominal voltage/current, and terminal type:

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

TM3 Expert Modules

The following table shows the TM3 expert modules.

Reference	Channels	I/O Types	Voltage	Terminal Type / Pitch
TM3XTYS4	4	3 regular inputs (sink) per channel	24 Vdc Type 1 (IEC/ EN 61131-2)	4 front connectors RJ-45
		2 regular transistor outputs (source) per channel	24 Vdc / 0.3 A	
TM3XHSC202	-	10 inputs	24 Vdc / 7.5 mA	Removable screw terminal block / 3.81 mm
		8 outputs	24 Vdc / 0.3 A	
TM3XHSC202G	-	10 inputs	24 Vdc / 7.5 mA	Removable spring terminal block / 3.81 mm
		8 outputs	24 Vdc / 0.3 A	

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 section.

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

TM3 Safety Modules

This table contains the TM3 safety modules, with the corresponding channel type, nominal voltage/current, and terminal type:

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

(1) Depending on external wiring

(2) Non-monitored start

TM4 Expansion Modules

TM4 Expansion Modules

The following table shows the TM4 expansion module features:

Reference	Description	Terminal Type / Pitch
TM4ES4	Ethernet stand-alone switch communication	4 RJ45 connectors 1 screw for functional ground connection

Accessories

Overview

This section describes the accessories and cables.

Accessories

Reference	Description	Use	Quantity
TMASD1	SD Card	Use to update the controller firmware, initialize a controller with a new application or clone a controller, apply post configuration file to the controller, store recipe files, and receive data logging files.	1
TMAT2PSET	Set of 5 removable screw terminal block	Connects 24 Vdc power supply.	
NSYTRAAB35	End brackets	Helps secure the controller or receiver module and their expansion modules on a top hat section rail (DIN rail).	
TM2XMTGB	Grounding bar	Connects the cable shield and the module to the functional ground.	
TM200RSRCEMC	Shielding take-up clip	Mounts and connects the ground to the cable shielding.	25 pack

Cables

Reference	Description	Details	Length
490NTW000••	Ethernet shielded cable for DTE connections	Standard cable, equipped with RJ45 connectors at each end for DTE. CE compliant.	2, 5, 12, 40, or 80 m (6.56, 16.4, 39.37, 131.23 or 262.47 ft)
490NTW000••U		Standard cable, equipped with RJ45 connectors at each end for DTE. UL compliant.	
TCSECE3M3M••S4		Cable for harsh environment, equipped with RJ45 connectors at each end. CE compliant.	1, 2, 3, 5, or 10 m (3.28, 6.56, 9.84, 16.4, 32.81 ft)
TCSECU3M3M••S4		Cable for harsh environment, equipped with RJ45 connectors at each end. UL compliant.	
TCSMCN3M4M3S2		RS-232 serial link cordset for DCE terminal. 1 RJ45 connector and 1 SUB-D 9 connector.	3 m (9.84 ft)
VW3A8306R••		Cable equipped with RJ45 connectors at each end for Modbus serial link. 2 RJ45 connectors.	0.3, 1, or 3 m (0.98, 3.28, or 9.84 ft)

M251 Distributed PAC Features

Overview

This chapter describes the Modicon M251 distributed PAC features.

Related Library

The related library for M251 distributed PAC in EcoStruxure Automation Expert is **SE.DPAC**.

M251 Distributed PAC States and Behaviors

Processor Load Management

Processor Load	Duration	Behavior
More than 98%	> 2 s	The controller is rebooted automatically and goes to CLEANED state. The TM3 expansion modules outputs are forced to 0. The ERR LED flashes fast.

The controller goes to HALTED state if the TM3 Watchdog time exceeds 1.5 seconds or if there is an EcoStruxure Automation Expert timeout.

Log information is stored in log files for use by the Schneider Electric Technical Support. See **Fetch Log Files > Log Files** in the EcoStruxure Automation Expert software.

Match Physical TM3 Configuration with Application

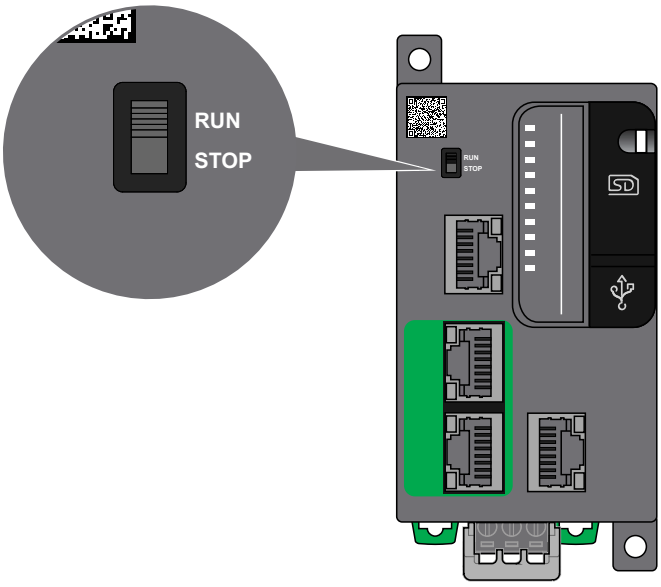
The controller goes to HALTED state if the physical TM3 bus configuration does not match the application configuration.

Refer to Optional I/O Expansion Modules, page 68 to mark TM3 I/O expansion modules as optional. This feature provides a more flexible configuration.

Run/Stop Switch

Overview

The M251 distributed PAC has a RUN/STOP switch:



When the RUN/STOP switch is set to STOP:

- the controller goes to STOPPED state
- the transition to RUN is only possible one time after restart of the Runtime

When the RUN/STOP switch is set to RUN:

- the controller will apply the Runtime configuration settings at boot

Real Time Clock (RTC)

Overview

The M251 distributed PAC includes a Real-Time Clock (RTC) to provide system date and time information, and to support related functions requiring a real-time clock. To continue keeping time when power is off, a non-rechargeable battery is required (see reference below). A battery LED on the front panel of the controller indicates if the battery is depleted or absent.

This table shows how RTC drift is managed:

RTC Characteristics	Description
RTC drift	Less than 60 seconds per month at 25 °C (77 °F)

In EcoStruxure Automation Expert, the **NTP Server Configuration** allows you to activate the RTC time automatic adjustment.

Battery

The controller has one battery.

In the event of a power interruption, the backup battery maintains the RTC for the controller.

This table shows the characteristics of the battery:

Characteristics	Description
Use	In the event of a transient power outage, the battery powers the RTC.
Backup life	At least 2 years at 25 °C maximum (77 °F). At higher temperatures, the time is reduced.
Battery monitoring	Yes
Replaceable	Yes
Controller battery type	Lithium carbon monofluoride, type Panasonic BR2032

Installing and Replacing the Battery

While lithium batteries are preferred due to their slow discharge and long life, they can present hazards to personnel, equipment and the environment and must be handled properly.

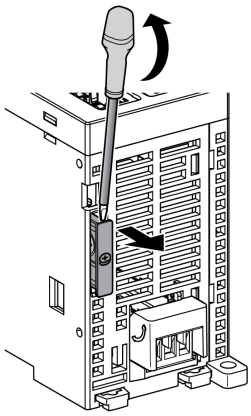
⚠ DANGER

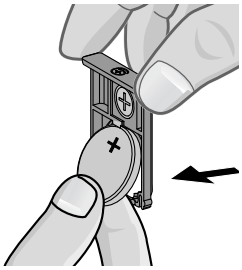
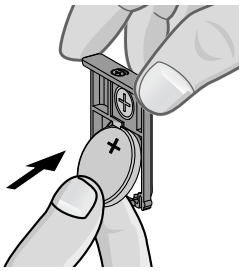
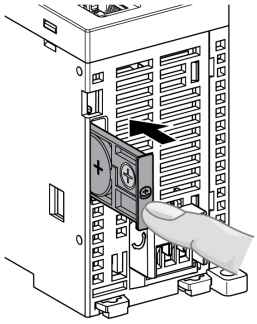
EXPLOSION, FIRE, OR CHEMICAL BURNS

- Replace with identical battery type.
- Follow all the instructions of the battery manufacturer.
- Remove all replaceable batteries before discarding unit.
- Recycle or properly dispose of used batteries.
- Protect battery from any potential short-circuit.
- Do not recharge, disassemble, heat above 100 °C (212 °F), or incinerate.
- Use your hands or insulated tools to remove or replace the battery.
- Maintain proper polarity when inserting and connecting a new battery.

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

To install or replace the battery, follow these steps:

Step	Action
1	Remove power from your controller.
2	Use an insulated screw-driver to pull out the battery holder. 
3	Side out the battery holder of the controller

Step	Action
4	Remove the battery from the battery holder. 
5	Insert the new battery into the battery holder in accordance with the polarity markings on the battery. 
6	Slide in the battery holder of the controller and verify that the latch clicks into place. 
7	Power up your M251 distributed PAC.
8	Set the internal clock.

NOTE: Replacement of the battery in the controllers other than with the type specified in this documentation may present a risk of fire or explosion.

⚠WARNING

IMPROPER BATTERY CAN PROVOKE FIRE OR EXPLOSION

Replace battery only with identical type: Panasonic Type BR2032.

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

M251 Distributed PAC Installation

Overview

This chapter provides installation safety guidelines, device dimensions, mounting instructions, and environmental specifications.

M251 Distributed PAC General Rules for Implementing

Environmental Characteristics

Enclosure Requirements

The M251 distributed PAC system components are designed as Zone B, Class A industrial equipment according to IEC/CISPR Publication 11. If they are used in environments other than those described in the standard, or in environments that do not meet the specifications in this manual, the ability to meet electromagnetic compatibility requirements in the presence of conducted and/or radiated interference may be reduced.

The M251 distributed PAC system components meet European Community (CE) requirements for open equipment as defined by IEC/EN 61131-2. You must install them in an enclosure designed for the specific environmental conditions and to minimize the possibility of unintended contact with hazardous voltages. Use metal enclosures to improve the electromagnetic immunity of your M251 distributed PAC system. Use enclosures with a keyed locking mechanism to minimize unauthorized access.

Environmental Characteristics

The M251 distributed PAC module components are electrically isolated between the internal electronic circuit and the input/output channels within the limits set forth and described by these environmental characteristics. For more information on electrical isolation, see the technical specifications of your particular controller found later in the current document. This equipment meets CE requirements as indicated in the table below. This equipment is intended for use in a Pollution Degree 2 industrial environment.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table shows the general environmental characteristics:

Characteristic	**Minimum Specification**	**Tested Range**	
Standard compliance	IEC/EN 61131-2 IEC/EN 61010-2-201	–	
Ambient operating temperature	–	Horizontal installation	-10...55 °C (14...131 °F)
	–	Vertical installation	-10...35 °C (14...95 °F)
Storage temperature	–	-25...70 °C (-13...158 °F)	
Relative humidity	–	Transport and storage	10...95 % (non-condensing)
		Operation	10...95 % (non-condensing)
Degree of pollution	IEC/EN 60664-1	2	
Degree of protection	IEC/EN 60529	IP20 with protective covers in place	
Corrosion immunity	–	Atmosphere free from corrosive gases	
Operating altitude	–	0...2000 m (0...6560 ft)	
Storage altitude	–	0...3000 m (0...9843 ft)	
Vibration resistance	IEC/EN 61131-2	Panel mounting or mounted on a top hat section rail (DIN rail)	3.5 mm (0.13 in) fixed amplitude from 5...8.4 Hz 9.8 m/s^2 (32.15 ft/s^2) (1 g_n) fixed acceleration from 8.4...150 Hz 10 mm (0.39 in) fixed amplitude from 5...8.7 Hz 29.4 m/s^2 (96.45 ft/s^2) (3 g_n) fixed acceleration from 8.7...150 Hz
Mechanical shock resistance	–	147 m/s^2 or 482.28 ft/s^2 (15 g_n) for a duration of 11 ms	

NOTE: The tested ranges may indicate values beyond that of the IEC Standard. However, our internal standards define what is necessary for industrial environments. In all cases, we uphold the minimum specification if indicated.

Electromagnetic Susceptibility

The M251 distributed PAC system meets electromagnetic susceptibility specifications as indicated in the following table:

Characteristic	Minimum Specification	Tested Range		
Electrostatic discharge	IEC/EN 61000-4-2 IEC/EN 61131-2	8 kV (air discharge) 4 kV (contact discharge)		
Radiated electromagnetic field	IEC/EN 61000-4-3 IEC/EN 61131-2	10 V/m (80...1000 MHz) 3 V/m (1.4...2 GHz) 1 V/m (2...3 GHz)		
Fast transients burst	IEC/EN 61000-4-4 IEC/EN 61131-2	24 Vdc main power lines	2 kV (CM[1] and DM[2])	
		24 Vdc I/Os	2 kV (clamp)	
		Relay output	1 kV (clamp)	
		Digital I/Os	1 kV (clamp)	
		Communication line	1 kV (clamp)	
Surge immunity	IEC/EN 61000-4-5 IEC/EN 61131-2	–	CM[1]	DM[2]
		DC Power lines	0.5 kV	0.5 kV
		Relay Outputs	–	–
		24 Vdc I/Os	–	–
		Shielded cable (between shield and ground)	1 kV	–
Induced electromagnetic field	IEC/EN 61000-4-6 IEC/EN 61131-2	10 Vrms (0.15...80 MHz)		
Conducted emission	IEC 61000-6-4 IEC/EN 61131-2	• 10...150 kHz: 120...69 dBµV/m QP • 150...1500 kHz: 79...63 dBµV/m QP • 1.5...30 MHz: 63 dBµV/m QP		
Radiated emission	IEC 61000-6-4 IEC/EN 61131-2	30...230 MHz: 40 dBµV/m QP 230...1000 MHz: 47 dBµV/m QP		

1 Common Mode

2 Differential Mode

NOTE: The tested ranges may indicate values beyond that of the IEC Standard. However, our internal standards define what is necessary for industrial environments. In all cases, we uphold the minimum specification if indicated.

Certifications and Standards

Introduction

For information on certifications and conformance to standards, go to www.se.com.

For product compliance and environmental information (RoHS, REACH, PEP, EOLI, etc.), go to www.se.com/green-premium.

M251 Distributed PAC Installation

Installation and Maintenance Requirements

Before Starting

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

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

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

Disconnecting Power

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

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

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

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

Programming Considerations

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

Operating Environment

In addition to the **Environmental Characteristics**, refer to **Product Related Information** in the beginning of the present document for important information regarding installation in hazardous locations for this specific equipment.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

Installation Considerations

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

NOTE: JDYX2 or JDYX8 fuse types are cULus-recognized.

M251 Distributed PAC Mounting Positions and Clearances

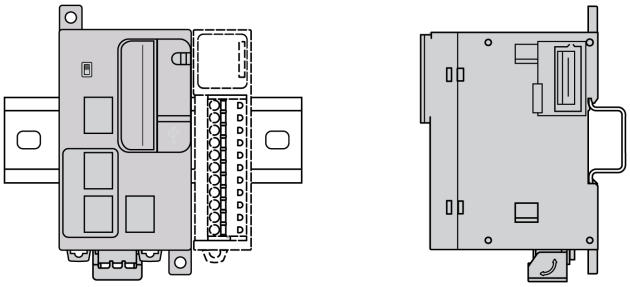
Introduction

This section describes the correct mounting positions for the M251 distributed PAC.

NOTE: Keep adequate spacing for proper ventilation and to maintain the operating temperature specified in the Environmental Characteristics, page 33.

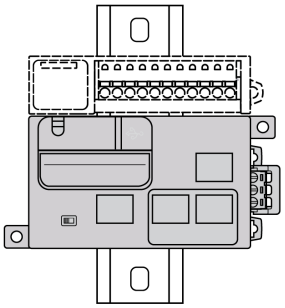
Correct Mounting Position

To obtain optimal operating characteristics, the M251 distributed PAC should be mounted horizontally on a vertical plane as shown in the figure below:



Acceptable Mounting Positions

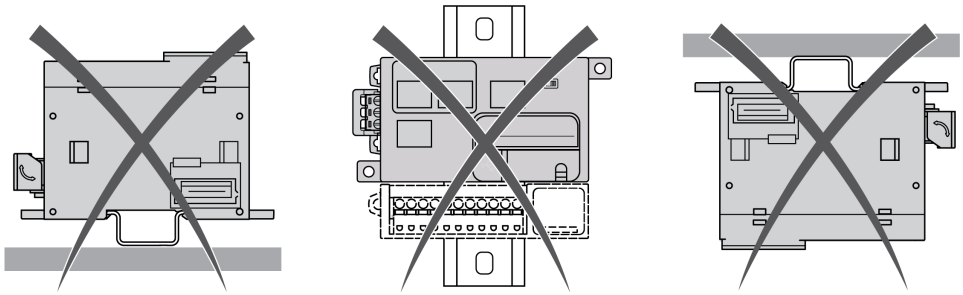
The M251 distributed PAC can also be mounted vertically on a vertical plane as shown below.



NOTE: TM3 expansion modules must be mounted above the controller.

Incorrect Mounting Position

The M251 distributed PAC should only be positioned as shown in the Correct Mounting Position figure. The figures below show the incorrect mounting positions.



Minimum Clearances

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Place devices dissipating the most heat at the top of the cabinet and ensure adequate ventilation.
- Avoid placing this equipment next to or above devices that might cause overheating.
- Install the equipment in a location providing the minimum clearances from all adjacent structures and equipment as directed in this document.
- Install all equipment in accordance with the specifications in the related documentation.

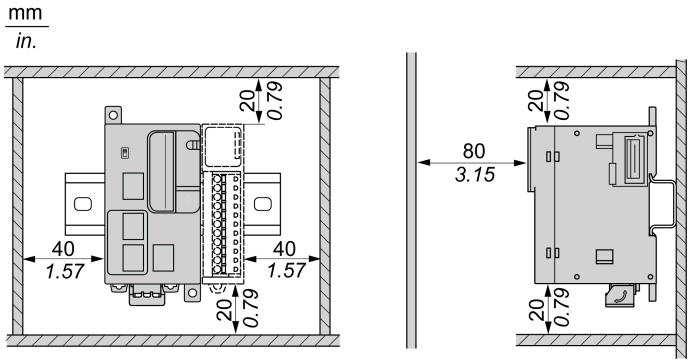
Failure to follow these instructions can result in death, serious injury, or equipment damage.

The M251 distributed PAC has been designed as an IP20 product and must be installed in an enclosure. Clearances must be respected when installing the product.

There are 3 types of clearances to consider:

- The M251 distributed PAC and all sides of the cabinet (including the panel door).
- The M251 distributed PAC terminal blocks and the wiring ducts to help reduce potential electromagnetic interference between the controller and the duct wiring.
- The M251 distributed PAC and other heat generating devices installed in the same cabinet.

The following figure shows the minimum clearances that apply to all M251 distributed PAC references:



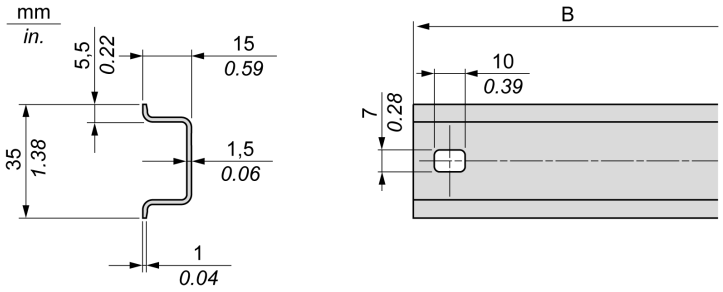
Top Hat Section Rail (DIN rail)

Dimensions of Top Hat Section Rail DIN Rail

You can mount the controller or receiver and their expansions on a 35 mm (1.38 in.) top hat section rail (DIN rail). The DIN rail can be attached to a smooth mounting surface or suspended from a EIA rack or mounted in a NEMA cabinet.

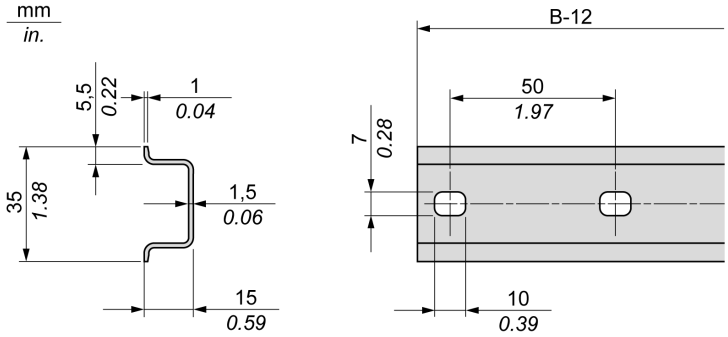
Symmetric Top Hat Section Rails (DIN Rail)

The following illustration and table indicate the references of the top hat section rails (DIN rail) for the wall-mounting range:



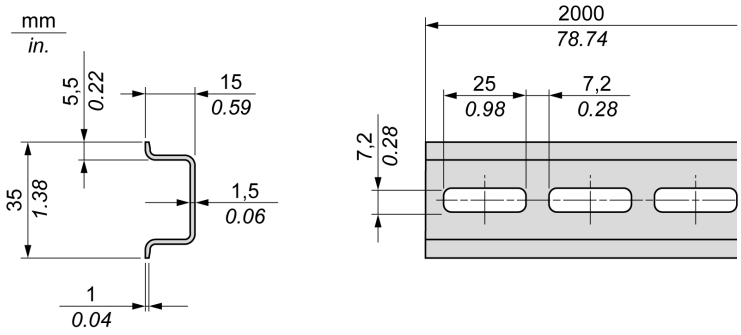
Reference	Type	Rail Length (B)
NSYSDR50A	A	450 mm (17.71 in.)
NSYSDR60A	A	550 mm (21.65 in.)
NSYSDR80A	A	750 mm (29.52 in.)
NSYSDR100A	A	950 mm (37.40 in.)

The following illustration and table indicate the references of the symmetric top hat section rails (DIN rail) for the metal enclosure range:



Reference	Type	Rail Length (B-12 mm)
NSYSDR60	A	588 mm (23.15 in.)
NSYSDR80	A	788 mm (31.02 in.)
NSYSDR100	A	988 mm (38.89 in.)
NSYSDR120	A	1188 mm (46.77 in.)

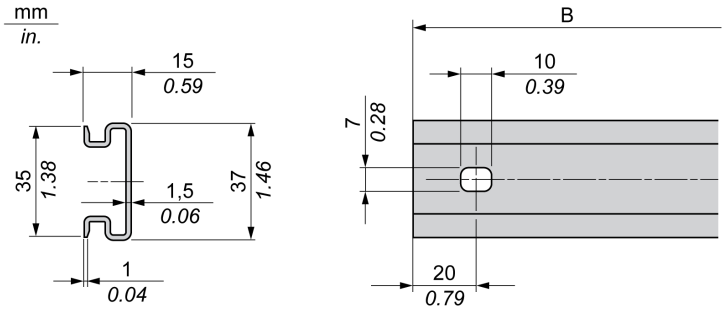
The following illustration and table indicate the references of the symmetric top hat section rails (DIN rail) of 2000 mm (78.74 in.):



Reference	Type	Rail Length
NSYSDR200[1]	A	2000 mm (78.74 in.)
NSYSDR200D[2]	A	
1 Unperforated galvanized steel **2** Perforated galvanized steel		

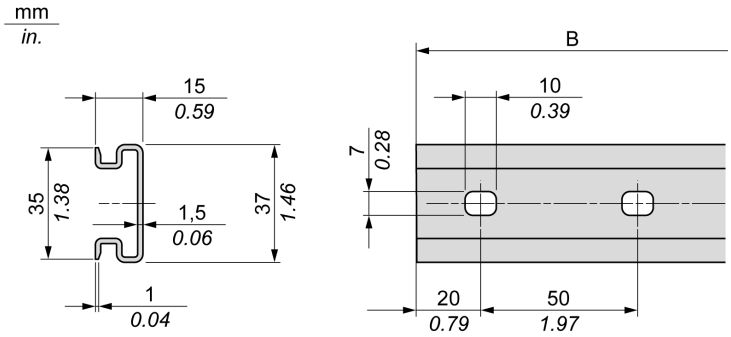
Double-Profile Top Hat Section Rails (DIN rail)

The following illustration and table indicate the references of the double-profile top hat section rails (DIN rails) for the wall-mounting range:



Reference	Type	Rail Length (B)
NSYDPR25	W	250 mm (9.84 in.)
NSYDPR35	W	350 mm (13.77 in.)
NSYDPR45	W	450 mm (17.71 in.)
NSYDPR55	W	550 mm (21.65 in.)
NSYDPR65	W	650 mm (25.60 in.)
NSYDPR75	W	750 mm (29.52 in.)

The following illustration and table indicate the references of the double-profile top hat section rails (DIN rail) for the floor-standing range:



Reference	Type	Rail Length (B)
NSYDPR60	F	588 mm (23.15 in.)
NSYDPR80	F	788 mm (31.02 in.)
NSYDPR100	F	988 mm (38.89 in.)
NSYDPR120	F	1188 mm (46.77 in.)

Installing and Removing the Controller with Expansions

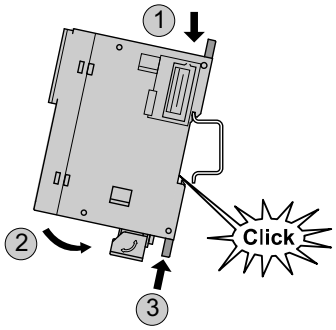
Overview

This section describes how to install and remove the controller with its expansion modules from a top hat section rail (DIN rail).

To assemble expansion modules to a controller or receiver module, or to other modules, refer to the respective expansion modules hardware guide(s).

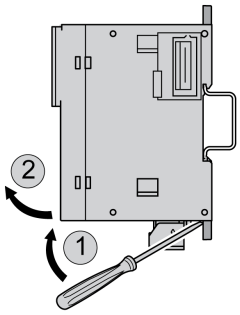
Installing a Controller with its Expansions on a DIN Rail

The following procedure describes how to install a controller with its expansion modules on a top hat section rail (DIN rail):

Step	Action
1	Fasten the top hat section rail (DIN rail) to a panel surface using screws.
2	Position the top groove of the controller and its expansion modules on the top edge of the DIN rail and press the assembly against the top hat section rail (DIN rail) until you hear the top hat section rail (DIN rail) clip snap into place. 
3	Place 2 terminal block end clamps on both sides of the controller and expansion module assembly.  **NOTE:** Type NSYTRAAB35 or equivalent terminal block end clamps help minimize sideways movement and improve the shock and vibration characteristics of the controller and expansion module assembly.

Removing a Controller with its Expansions from a Top Hat Section Rail (DIN Rail)

The following procedure describes how to remove a controller with its expansion modules from a top hat section rail (DIN rail):

Step	Action
1	Remove all power from your controller and expansion modules.
2	Insert a flat screwdriver into the slot of the top hat section rail (DIN rail) clip. 
3	Pull down the DIN rail clip.
4	Pull the controller and its expansion modules from the top hat section rail (DIN rail) from the bottom.

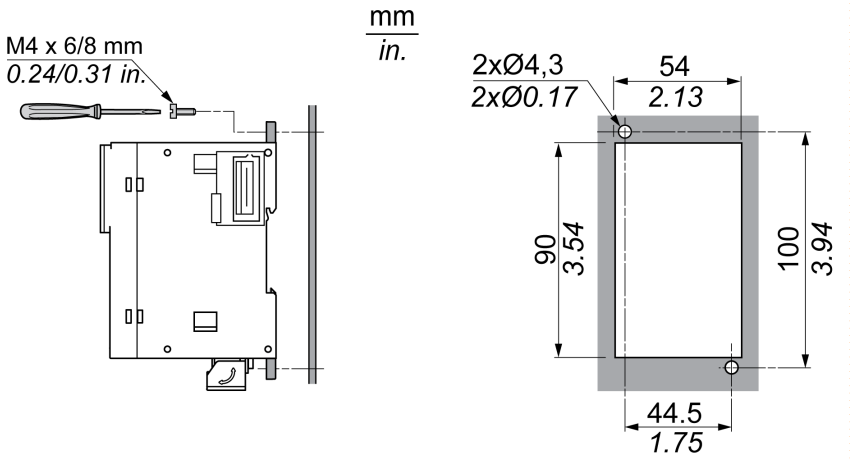
Direct Mounting on a Panel Surface

Overview

This section shows how to install M251 distributed PAC on a panel surface using the mounting holes.

Mounting Hole Layout

This diagram shows the mounting hole layout for M251 distributed PAC:



M251 Distributed PAC Electrical Requirements

Wiring Best Practices

Overview

This section describes the wiring guidelines and associated best practices to be respected when using the M251 distributed PAC system.

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

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

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

⚠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.

Wiring Guidelines

These rules must be applied when wiring an M251 distributed PAC system:

- Communication wiring must be kept separate from the power wiring. Route these 2 types of wiring in separate cable ducting.
- Verify that the operating conditions and environment are within the specification values.
- Use proper wire sizes to meet voltage and current requirements.
- Use copper conductors (required).
- Use twisted pair, shielded cables for networks, and fieldbus.

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Use shielded cables for all communication signals.
- Ground cable shields for all communication signals at a single point[1].
- Route communication separately from power cables.

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

[1]Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

For more details, refer to Grounding Shielded Cables, page 50.

NOTE: Surface temperatures may exceed 60 °C (140 °F).

To conform to IEC 61010 standards, route primary wiring (wires connected to power mains) separately and apart from secondary wiring (extra low voltage wiring coming from intervening power sources). If that is not possible, double insulation is required such as conduit or cable gains.

Rules for Removable Screw Terminal Block

The following tables show the cable types and wire sizes for a **5.08 pitch** removable screw terminal block (power supply):

mm / in. 7 / 0.28								
mm^2	0.2…2.5	0.2…2.5	0.25…2.5	0.25…2.5	2 x 0.2…1	2 x 0.2…1.5	2 x 0.25…1	2 x 0.5...1.5
AWG	*24…14*	*24…14*	*23...14*	*23...14*	*2 x 24…17*	*2 x 24…16*	*2 x 23…17*	*2 x 20...16*

Ø 3,5 mm (*0.14 in.*)	C	N•m	0.5...0.6
		lb-in	*4.42...5.31*

The use of copper conductors is required.

⚠⚠DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

Tighten connections in conformance with the torque specifications.

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

⚠DANGER

FIRE HAZARD

Use only the correct wire sizes for the maximum current capacity of the power supplies.

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

DC Power Supply Characteristics and Wiring

Overview

This section provides the characteristics and the wiring diagrams of the DC power supply.

DC Power Supply Voltage Range

If the specified voltage range is not maintained, outputs may not switch as expected. Use appropriate safety interlocks and voltage monitoring circuits.

⚠DANGER

FIRE HAZARD

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

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

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

DC Power Supply Requirements

The M251 distributed PAC and associated I/O TM3 require power supplies with a nominal voltage of 24 Vdc. The 24 Vdc power supplies must be rated Protective Extra Low Voltage (PELV) according to IEC 61140. These power supplies are isolated between the electrical input and output circuits of the power supply.

⚠WARNING

POTENTIAL OF OVERHEATING AND FIRE

- Do not connect the equipment directly to line voltage.
- Use only isolating PELV power supplies and circuits to supply power to the equipment[1].

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

[1] For compliance to UL (Underwriters Laboratories) requirements, the power supply must also conform to the various criteria of NEC Class 2, and be inherently current limited to a maximum power output availability of less than 100 VA

(approximately 4 A at nominal voltage), or not inherently limited but with an additional protection device such as a circuit breaker or fuse meeting the requirements of clause 9.4 Limited-energy circuit of UL 61010-1. In all cases, the current limit should never exceed that of the electric characteristics and wiring diagrams for the equipment described in the present documentation. In all cases, the power supply must be grounded, and you must separate Class 2 circuits from other circuits. If the indicated rating of the electrical characteristics or wiring diagrams are greater than the specified current limit, multiple Class 2 power supplies may be used.

Controller DC Characteristics

This table shows the characteristics of the DC power supply required for the controller:

Characteristic		**Value**
Rated voltage		24 Vdc
Power supply voltage range		19.2...28.8 Vdc
Power interruption time		10 ms at 24 Vdc
Maximum inrush current		50 A
Power consumption		32.6 W, maximum 40.4 W(1)
Isolation	between DC power supply and internal logic	Not isolated
	between DC power supply and protective earth ground (PE)	500 Vac
(1) Controller + 7 TM3 expansion modules		

Power Interruption

The duration of power interruptions where the M251 distributed PAC is able to continue normal operation varies depending upon the load to the power supply of the controller, but a minimum of 10 ms is maintained as specified by IEC standards.

When planning the management of the power supplied to the controller, you must consider the power interruption duration due to the fast cycle time of the controller.

There could potentially be many scans of the logic and consequential updates to the I/O image table during the power interruption, while there is no external power supplied to the inputs, the outputs or both depending on the power system architecture and power interruption circumstances.

⚠WARNING

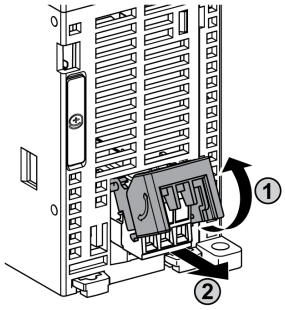
UNINTENDED EQUIPMENT OPERATION

- Individually monitor each source of power used in the controller system including input power supplies, output power supplies and the power supply to the controller to allow appropriate system shutdown during power system interruptions.
- The inputs monitoring each of the power supply sources must be unfiltered inputs.

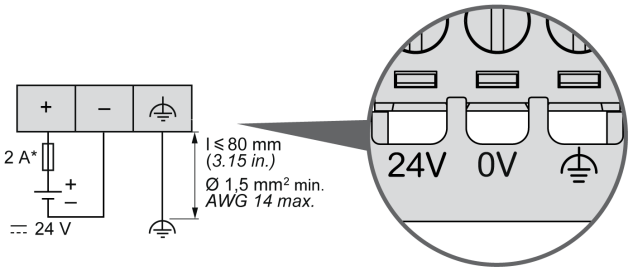
Failure to follow these instructions can result in death, serious injury, or equipment damage.

DC Power Supply Wiring Diagram

This figure shows the power supply terminal block removal procedure:



The following figure shows the wiring of the DC power supply:



***** Type T fuse

For more information, refer to the 5.08 pitch Rules for Removable Screw Terminal block, page 46.

Grounding the M251 Distributed PAC System

Overview

To help minimize the effects of electromagnetic interference, cables carrying fieldbus communication signals must be shielded.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Use shielded cables for communication signals.
- Ground cable shields for communication signals at a single point [1].
- Always comply with local wiring requirements regarding grounding of cable shields.

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

[1]Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

The use of shielded cables requires compliance with the following wiring rules:

- For protective ground connections (PE), metal conduit or ducting can be used for part of the shielding length, provided there is no break in the continuity of the ground connections. For functional ground (FE), the shielding is intended to attenuate electromagnetic interference and the shielding must be continuous for the length of the cable. If the purpose is both functional and protective, as is often the case for communication cables, the cable must have continuous shielding.
- Wherever possible, keep cables carrying one type of signal separate from the cables carrying other types of signals or power.

Protective Ground (PE) on the Backplane

The protective ground (PE) should be connected to the conductive backplane by a heavy-duty wire, usually a braided copper cable with the maximum allowable cable section.

Shielded Cables Connections

Cables carrying fieldbus communication signals must be shielded. The shielding must be securely connected to ground. The fieldbus communication cable shields must be connected to the protective ground (PE) with a connecting clamp secured to the conductive backplane of your installation.

The shielding of the Modbus cable must be connected to the protective ground (PE).

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK

- The grounding terminal connection (PE) must be used to provide a protective ground at all times.
- Make sure that an appropriate, braided ground cable is attached to the PE/PG ground terminal before connecting or disconnecting the network cable to the equipment.

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

⚠WARNING

ACCIDENTAL DISCONNECTION FROM PROTECTIVE GROUND (PE)

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

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

Modicon M251 Distributed PAC Communication

Integrated Communication Ports

Ethernet Ports

Overview

The M251 distributed PAC is equipped with Ethernet communications ports:

Reference	Number of Ports	Port Name
TM251MDESE	2 (one dual Ethernet port switch)	Ethernet 1
	1	Ethernet 2

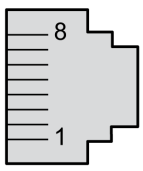
Characteristics

This table describes the different Ethernet characteristics:

Characteristic	Description	Ethernet 1	Ethernet 2
Function	Modbus TCP/IP client	Available	Available
	Modbus TCP/IP server	Available	Available
	EcoStruxure Automation Expert protocol	Available	Available
	EcoStruxure Automation Device Management protocol	Available	Available
	EtherNet/IP scanner	Not available	Available
	EtherNet/IP explicit message	Available	Available
	OPC UA server	Available	Available
	NTP client	Available	Available
Connector type	RJ45		
Auto negotiation	From 10 Mbps half duplex to 100 Mbps full duplex		
Cable type	Shielded		
Automatic cross-over detection	Yes		
Denial-of-service protection	The Ethernet 2 interface is disabled for 8 seconds: • When an important quantity of frames is lost, such as is the case during a "network storm" or repeated reception of incorrect frames, or • When the number of frames per second becomes too great.		
NOTE: For the same protocol, Ethernet 2 is faster than Ethernet 1.			

Pin Assignment

This figure shows the RJ45 Ethernet connector pin assignment:



This table describes the RJ45 Ethernet connector pins:

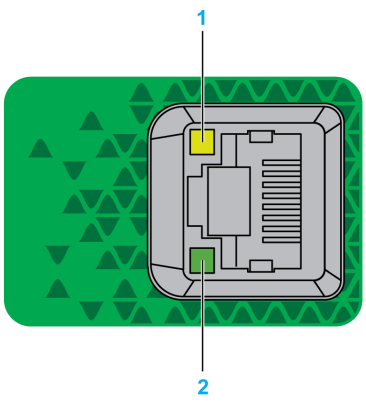
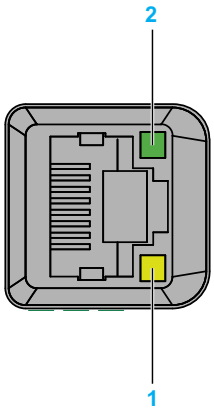
Pin N°	Signal
1	TD+
2	TD-
3	RD+
4	-
5	-
6	RD-
7	-
8	-

NOTE: The controller supports the MDI/MDIX auto-crossover cable function. It is not necessary to use special Ethernet crossover cables to connect devices directly to this port (connections without an Ethernet hub or switch).

NOTE: Ethernet cable disconnection is detected every second. In case of disconnection of a short duration (< 1 second), the network status may not indicate the disconnection.

Status LEDs

These figures show the RJ45 connectors status LEDs:

Ethernet 1	Ethernet 2
	

This table describes the Ethernet status LEDs:

Label	Description	LED		
		Color	Status	Description
1	Ethernet link/ speed	Green/ Yellow	Off	No link
			Solid yellow	Link at 10 Mbps
			Solid green	Link at 100 Mbps
2	Ethernet activity	Green	Off	No activity and no link
			On	The link is detected, but there is no activity
			Flashing	Transmitting or receiving data

USB Mini-B Port

Overview

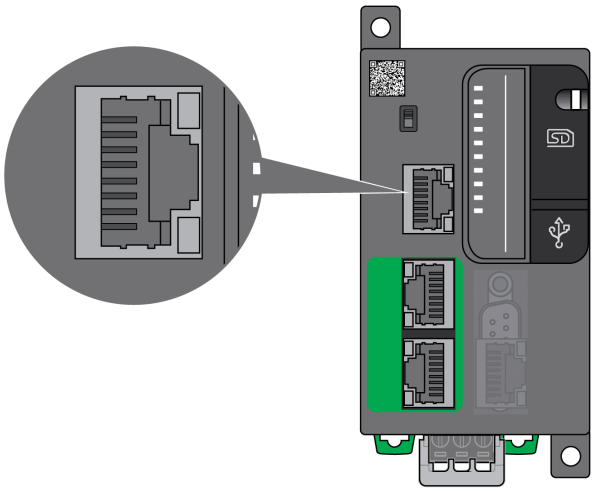
The USB Mini-B port is used for the “powerless” updates. You can use the port to power the controller, and then update the application or firmware via the Ethernet port without connecting the main power.

Serial Line Port

Overview

The serial line:

- Is used to communicate as Modbus RTU.
- Provides a 5 Vdc power distribution.



Characteristics

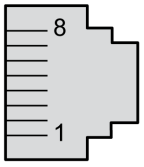
Characteristic		Description
Function		RS485 or RS232 software configured
Connector type		RJ45
Isolation		Non-isolated
Baud rate		• 1200 • 2400 • 4800 • 9600 • 19200 • 38400 • 57600 **NOTE:** Use of communication speeds (baud rates) greater than 19200 may impact the performance of your controller and/or provoke communication errors.
Cable	Type	Shielded
	Maximum length (between the controller and an isolated junction box)	15 m (49 ft) for RS485 3 m (9.84 ft) for RS232
Polarization		Software configuration is used to connect when the node is configured as a master. 560 Ω resistors are optional.
5 Vdc power supply for RS485		Yes

NOTE: Some devices provide voltage on RS485 serial connections. Do not connect these voltage lines to your controller as they may damage the controller serial port electronics and render the serial port inoperable.

NOTICE
INOPERABLE EQUIPMENT Use only the VW3A8306R•• serial cable to connect RS485 devices to your controller. **Failure to follow these instructions can result in equipment damage.**

Pin Assignment

The following figure shows the pins of the RJ45 connector:



This table describes the pin assignment of the RJ45 connector:

Pin	RS232	RS485
1	RxD	N.C.
2	TxD	N.C.
3	N.C.	N.C.
4	N.C.	D1
5	N.C.	D0
6	N.C.	N.C.
7	N.C. *	5 Vdc
8	Common	Common

*: 5 Vdc delivered by the controller, do not connect.

N.C.: No connection

RxD: Received data

TxD: Transmitted data

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N.C.)”.

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

Serial Line Configuration

The related libraries in EcoStruxure Automation Expert are **Standard.IoModbus** and **Standard.IoModbusSlave**.

This table describes the procedure to add the related library and to configure the serial line:

Step	Action
1	Right-click on the active **Solution**. Select **References** and add the library **Standard.IoModbus** or **Standard.IoModbusSlave** to the project library references.
2	Open the **System** tab and select the **Hardware Configuration** tab: the **Hardware Configuration** window opens.
3	In the **Hardware Configuration** window, right-click and select **Add**: the **Add Bus** window opens.
4	Select **Standard.IoModbus.MODBUSSERIAL** or **Standard.IoModbusSlave.MODBUSSERIAL**, click **Add** and **Close**.
5	Right-click on **MODBUSSERIAL** and select **Properties**.
6	Configure the serial line with the parameters listed in the **Properties > Connect info** window.

The following parameters must be identical for each serial device connected to the port:

Parameter	Default Value	Range	Description
Interframedelay	10	33...65535 for 1200 baud rate 17...65535 for 2400 baud rate 9...65535 for 4800 baud rate 5...65535 for 9600 baud rate 3...65535 for 19200 baud rate 2...65535 for 38400 baud rate 2...65535 for 57600 baud rate	Sets the inter frame delay for Modbus RTU communication in ms.
Port	COM1	COM1	Displays the COM port. **NOTE:** Changing the value has no effect.
Speed	19200	1200 2400 4800 9600 19200 38400 57600	Sets the COM port baud rate. **NOTE:** Use of communication speeds (baud rates) greater than 19200 may impact the performance of your controller and/or provoke communication errors.
Databits	8	8	Displays the number of bits for data transmitting. **NOTE:** You can not alter this setting.
Parity	E	N E O	Used for error detection. Sets the parity: • N for none • E for even • O for odd
Stopbits	1	1 2	Sets the number of stop bits.
Standard	RS485	RS232 RS485	Specifies the physical medium to use.
Polarization	No	Yes No	Polarization resistors are integrated in the controller. They are switched on or off by this parameter (only for RS485): • Yes for ON • No for OFF

Connecting the M251 Distributed PAC to a PC

Connecting the Controller to a PC

Overview

To transfer, run, and monitor the applications, connect the controller to a computer that has EcoStruxure Automation Expert installed, using an Ethernet connection.

NOTICE
INOPERABLE EQUIPMENT Always connect the communication cable to the PC before connecting it to the controller. **Failure to follow these instructions can result in equipment damage.**

IP Address Management

The default IP addresses are:

- 10.10.x.x for Ethernet_1
- 10.11.x.x for Ethernet_2

NOTE: The two IP addresses must not be in the same IP network.

The subnet 10.10.x.x is reserved to the Ethernet_1 interface and the subnet 10.11.x.x is reserved to the Ethernet_2 interface. For example, Ethernet_2 cannot be configured inside subnet 10.10.x.x even if the address of Ethernet_1 has been changed to another subnet.

If an invalid IP address has been configured, or if the configured IP address is already present on the network, the associated Ethernet interface is set to its default address as its fallback.

The IP routing is not supported; the communication is not routed from one Ethernet interface to another one.

MAC Address

The last two fields in the default IP address are composed of the decimal equivalent of the last two hexadecimal bytes of the MAC address of the port.

The MAC address of the port can be retrieved on the label placed on the front side of the controller.

The default subnet mask is 255.255.0.0.

NOTE: A MAC address is written in hexadecimal format and an IP address in decimal format. Convert the MAC address to decimal format. Example: If the MAC address is 00.80.F4.01.**80.F2**, the default IP address is 10.10.**128.242**.

Gateway Address

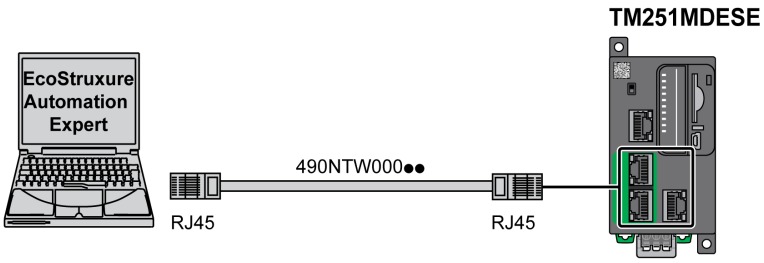
The gateway allows a message to be routed to a device that is not on the same network.

You can only configure one default gateway on the device. The default gateway address can be configured on any interface. The traffic to unknown networks is sent through this interface.

If there is no gateway, the gateway address is 0.0.0.0.

Ethernet Port Connection

You can connect the controller to a PC using an Ethernet cable:



To connect the controller to the PC, do the following:

Step	Action
1	Connect the Ethernet cable to the PC.
2	Connect the Ethernet cable to one of the Ethernet ports on the controller.

SD Card

SD Card Hardware Description

Overview

When handling the SD card, follow the instructions below to help prevent internal data on the SD card from being corrupted or lost or an SD card malfunction from occurring:

NOTICE

LOSS OF APPLICATION DATA

- Do not store the SD card where there is static electricity or probable electromagnetic fields.
- Do not store the SD card in direct sunlight, near a heater, or other locations where high temperatures can occur.
- Do not bend the SD card.
- Do not drop or strike the SD card against another object.
- Keep the SD card dry.
- Do not touch the SD card connectors.
- Do not disassemble or modify the SD card.
- Use only SD cards formatted using FAT or FAT32.

Failure to follow these instructions can result in equipment damage.

The M251 Distributed PAC does not recognize NTFS formatted SD cards. Format the SD card on your computer using FAT or FAT32.

When using the M251 Distributed PAC and an SD card, observe the following to avoid losing valuable data:

- Accidental data loss can occur at any time. Once data is lost it cannot be recovered.
- If you forcibly extract the SD card, data on the SD card may become corrupted.
- Removing an SD card that is being accessed could damage the SD card, or corrupt its data.
- If the SD card is not positioned correctly when inserted into the controller, the data on the card and the controller could become damaged.

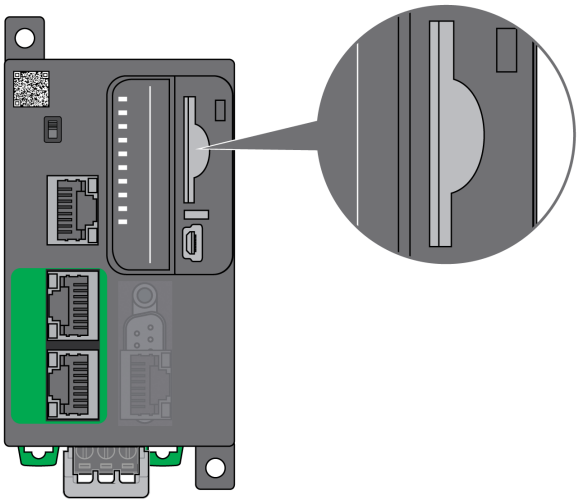
NOTICE

LOSS OF APPLICATION DATA

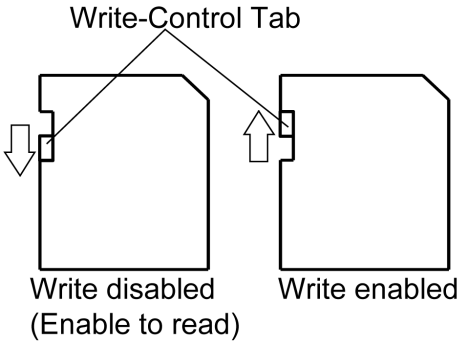
- Backup SD card data regularly.
- Do not remove power or reset the controller, and do not insert or remove the SD card while it is being accessed.

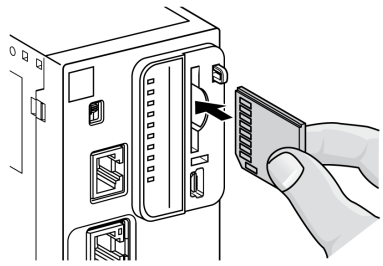
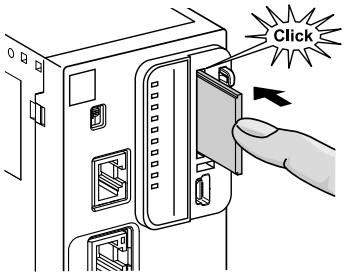
Failure to follow these instructions can result in equipment damage.

This figure shows the SD card slot:



It is possible to set the Write-Control Tab to prevent write operations to the SD card. Push the tab up, as shown in the example on the right-hand side, to release the lock and enable writing to the SD card. Before using an SD card, read the manufacturer's instructions.



Step	Action
1	Insert the SD card into the SD card slot: 
2	Push until you hear it “click”: 

SD Card Slot Characteristics

Topic	Characteristics	Description
Supported type	Standard Capacity	SD (SDSC)
	High Capacity	SDHC
Global memory	Size	16 GB maximum

TMASD1 Characteristics

Characteristics	Description
Card removal durability	Minimum 1000 times
File retention time	10 years @ 25 °C (77 °F)
Nonvolatile memory type	SLC NAND
Memory size	256 MB
Ambient operation temperature	-10…+85 °C (14...185 °F)
Storage temperature	-25…+85 °C (-13...185 °F)
Relative humidity	95% maximum non-condensing
Write/Erase cycles	3,000,000 (approximately)

Script SD Card Description

Overview

The following describes how to write script files to be executed from an SD card.

Script files can be used to perform commands.

Script Syntax Guidelines

The following describes the script syntax guidelines:

- To implement a comment, the text must begin with "`;`".
- The maximum number of lines in a script file is 50.
- The syntax is not case-sensitive.
- If the syntax is not respected in the script file, the script file is not executed.

SD Card Commands

Introduction

The M251 Distributed PAC allows you to execute commands with an SD card.

When an SD card is inserted into the SD card slot of the controller, the firmware searches for and executes the script contained in the SD card (*/sys/cmd/Script.cmd*).

When the controller has executed the script, the result is logged on the SD card (*/sys/cmd/Script.log*).

Care must be taken when inserting SD cards into a controller; you must understand the consequences of executing the script command given the context of controller and its state.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- You must have operational knowledge of your machine or process before connecting this device to your controller.
- Ensure that guards are in place so that any potential unintended equipment operation will not cause injury to personnel or damage to equipment.

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

NOTE: The controller contains log file */usr/Syslog/FWLog.txt*

Upload Command

The upload command allows you to retrieve files from the controller. Power must be applied to the controller before inserting the SD card. The script must contain this command:

```
Upload "path"
```

Example script to retrieve the log files:

```
Upload "/usr/Syslog/*"
```

Upload Procedure

The Upload procedure uploads files contained in a controller directory to the SD card:

Step	Action
1	Apply power to the controller.
2	Insert the prepared SD card in the source controller. **Result:** The operation starts automatically. During the operation, the SD LED flashes.
3	Wait until the operation is completed. **Result:** • The SD LED is ON if the operation is successful. • The I/O LED flashes if an error is detected.
4	Remove the SD card from the controller and verify the SD card file *Script.log*.

ResetOrigin Command

The ResetOrigin procedure allows you to return the controller to its default settings. Power must be removed from the controller before inserting the SD card.

The script must contain this command:

```
ResetOrigin
```

The effects of the ResetOrigin script command:

- Resets the default login (installer)
- Resets the default password (Inst@ller1)
- Deletes Cybersecurity configuration
- Deletes IP settings
- Deletes NTP settings
- Deletes user data
- Reinstalls the default backup firmware

ResetOrigin Procedure

The ResetOrigin procedure returns the controller to its default settings.

Step	Action
1	Remove power from the controller.
2	Insert the prepared SD card in the source controller.
3	Restore power to the source controller. **Result:** The operation starts automatically. During the operation, the SD LED flashes.
4	Wait until the operation is completed. **Result:** • The SD LED is ON and the ERR LED flashes if the operation is successful. • The ERR and I/O LEDs flash if an error is detected.
5	Remove the SD card from the controller and verify the SD card file *Script.log*.
6	Apply power to the controller.

Expansion Modules Configuration

TM3 I/O Configuration General Description

Introduction

You can add TM3 digital and analog I/O expansion modules to your M251 distributed PAC.

To learn more about how to configure M251 distributed PAC TM3 expansion modules and faceplates, watch Configure M251 dPAC in EcoStruxure Automation Expert.

For more details on how to configure the TM3 expansion modules, refer to the EcoStruxure Automation Expert Online Help.

Related Library

The related library in EcoStruxure Automation Expert is **SE.IoTMx**.

Configuring the Latch and Filter Parameters

Introduction

You can select the type of edge for the **Latch** parameter, refer to Latch Principles, page 66:

- Rising edge
- Falling edge
- Both edge
- None

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

NOTE: The lower the **Filter** value, the higher the effects of electromagnetic interference.

You can configure these parameters on the following modules:

- TM3DI8_G and TM3DI16_G digital expansion modules
- TM3DI16K and TM3DI32K digital expansion modules
- TM3DM8R_G and TM3DM24R_G digital expansion modules
- TM3XHSC202_G expert expansion modules (**Filter** only)

System Requirements

To configure the **Latch** and **Filter** parameters, the following system configuration is required:

- **SE.IoTMx** library: 22.0.0.8 or greater
- M251 distributed PAC firmware: 22.0.22066.01 or greater
- TM3 digital expansion modules: SV ≥ 2.0

If your TM3 digital expansion modules contain firmware SV < 2.0, you must configure the digital input channels with Parameters, page 65, set to default values. Otherwise the controller goes to HALTED state after deployment.

Configuration

This table describes how to configure the **Latch** and **Filter** parameters:

Step	Action
1	In the **HW Configuration** tab, right-click on the expansion module and select **Properties**.
2	Select a channel (each channel represents an input).
3	Configure the **Latch** and **Filter** parameters.

Parameters

This table describes the **Latch** and **Filter** parameters:

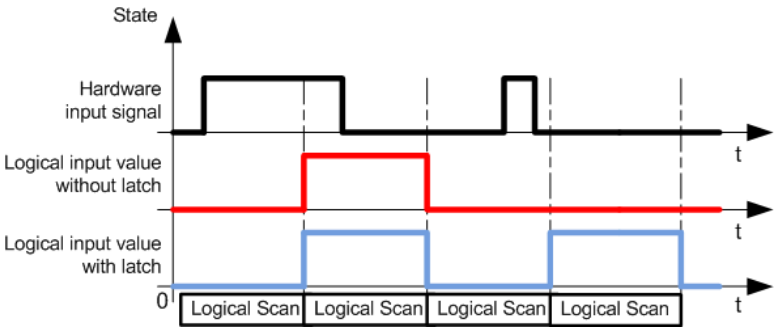
Parameter	Type	Value	Unit	Description
Latch	**Enumeration of BYTE**	**No*** **Both edges** **Rising edge** **Falling edge**	–	Latching allows incoming pulses with amplitude widths shorter than TM3 Bus cycle time to be captured and recorded.
Filter (digital expansion modules)	**Enumeration of BYTE**	**0** **0.3** **0.5** **1** **2** **4*** **12**	ms	Integrator filtering value reduces the effect of bounce on a controller input.
Filter (expert expansion modules)	**Enumeration of BYTE**	**0.000** **0.001** **0.002** **0.005** **0.01** **0.05** **0.08** **0.5** **1** **4*** **12**	ms	Integrator filtering value reduces the effect of bounce on a controller input.
* Parameter default value				

Latch Principles

Introduction

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

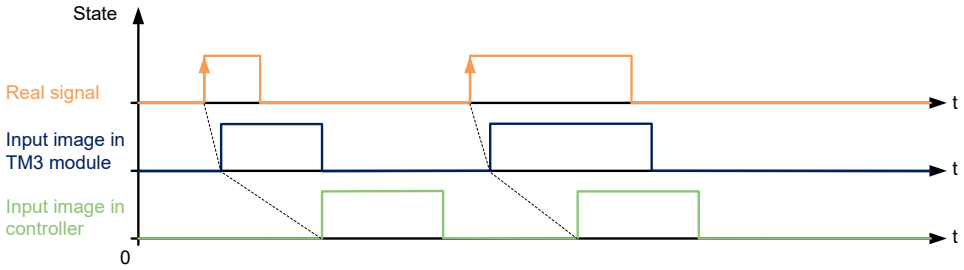
The following timing diagram illustrates the latching effects:



Several edge types can be selected for this parameter.

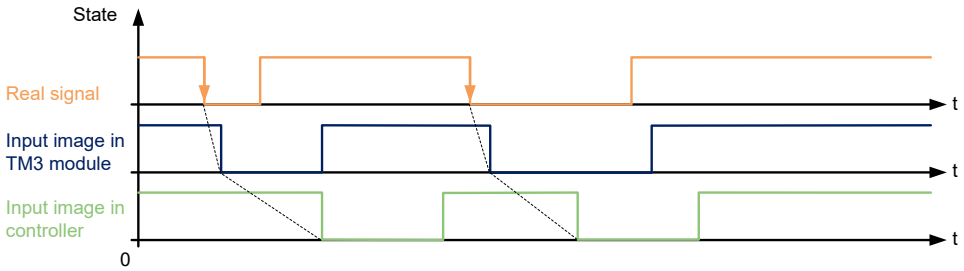
Rising edge

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



Falling edge

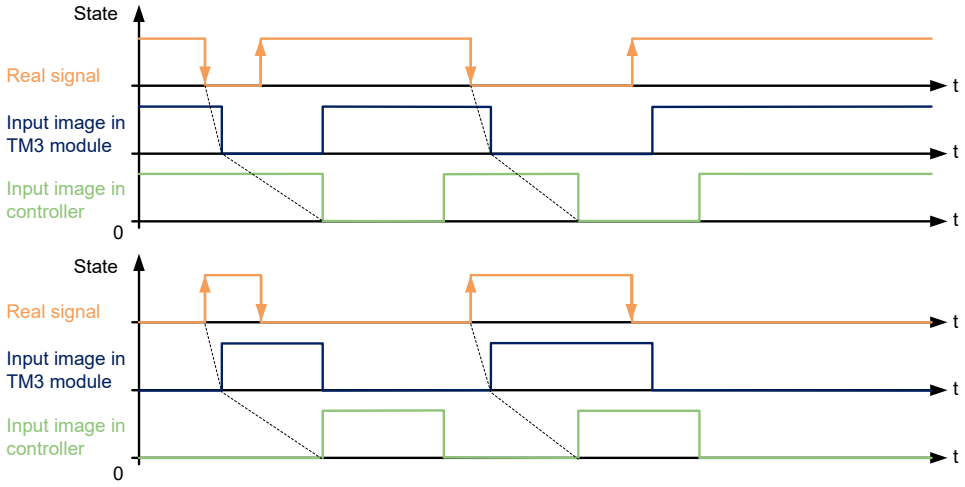
Latch falling edge allows the detection of a negative pulse whose width corresponds to the bounce filter value.



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.



Compatible Expansion Modules

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.

Replacing a module by another module with the same internal ID code does not imply that you rework the application.

This table shows the internal ID codes of expansion modules:

Modules sharing the same internal ID code	ID code
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
TM3DM24R, TM3DM24RG	135
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
TM3XHSC202, TM3XHSC202G	217

Optional I/O Expansion Modules

Presentation

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 controller switches to HALTED state.

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 switch to RUNNING state.

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 TM3 I/O expansion modules can be marked as optional.

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

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

You cannot have two modules with the same internal ID code with the first one marked as optional and the second one as mandatory.

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.

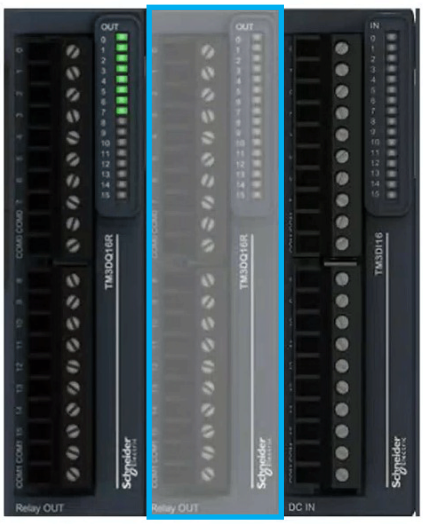
Marking an I/O Expansion Module as Optional

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

Step	Action
1	Add the expansion module to the **HW Configuration** tab.
2	In the **HW Configuration** tab, right-click on the expansion module and select **Properties**.
3	In the **Properties** window, select **Yes** on the **Optional Module** line.

Optional Modules HMI Display

I/O expansion modules marked as optional and not physically present are displayed grey in the HMI overview. No actions are allowed on a grey faceplate.



Firmware Update

Product Identification

Device Identification

Reference	Description	Software Version	Firmware Version	EADM(1) compatible version
TM251MDESE	Modicon M251 distributed PAC	21.2	21.2	3.0
		22.0	22.0	3.0
		22.1	22.1	3.1
		23.0	23.0	3.2
		23.1	23.1	3.2
(1) EcoStruxure Automation Device Maintenance				

Firmware Upgrade / Downgrade Compatibility

From \ To	21.2	22.0	22.1	23.0	23.1
21.2	Yes	Yes	Yes	Yes	No
22.0	No	Yes	Yes	Yes	No
22.1	No	Yes	Yes	Yes	No
23.0	No	Yes	Yes	Yes	Yes
23.1	No	No	No	Yes	Yes

To upgrade/downgrade the firmware, use a version of EcoStruxure Automation Device Maintenance compatible with the firmware version of the M251 distributed PAC. Refer to Device Identification, page 71.

Firmware Update Procedure

Introduction

The M251 distributed PAC firmware update procedure consists of:

1. Selecting the Firmware Data Package, page 72
2. Updating the Firmware, page 73

A firmware update with EcoStruxure Automation Device Maintenance deletes the following elements from the controller:

- Application boot project and persistent data
- Device runtime configuration including Runtime configuration, OPC UA configuration, NTP settings
- Cyclic log and device log

The following elements are not deleted:

- Cybersecurity configuration (user login & password)
- IP settings

When updating the controller firmware with EcoStruxure Automation Device Maintenance, observe the following to avoid losing valuable data:

- Avoid power disconnection.
- Avoid cable disconnection.

If the update of the firmware is interrupted, you must restart the update process.

Selecting the Firmware Data Package

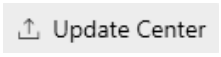
The following table describes how to install EcoStruxure Automation Device Maintenance and select the firmware data package with the EcoStruxure Automation Device Maintenance software:

Step	Action
1	Before updating your firmware, verify that the EcoStruxure Automation Device Maintenance version supports the firmware version you want to install. See Product Identification, page 71.
2	**2a**. Go to www.se.com and then select your Schneider Electric country web site. In the search bar, enter "Device Maintenance". You can filter the search results by selecting the **Software** tab. Select your version of EcoStruxure Automation Device Maintenance, then download and install it. **2b**. A version of EcoStruxure Automation Device Maintenance is also available in the EcoStruxure Automation Expert installation package. Unzip the folder and double-click the .exe file to install it.
3	The firmware packages can be found in the EcoStruxure Automation Expert installation package in the folder **Firmware > Prod**. Copy and paste the M251 distributed PAC firmware package (.sedp file) to the default EcoStruxure Automation Device Maintenance Data Packages folder. By default the folder is *C:\Users\Public\Documents\Schneider Electric\Data Packages*. The firmware packages are displayed in the EcoStruxure Automation Device Maintenance window in the DATA PACKAGE tab.
4	Before updating the firmware, confirm that the M251 distributed PAC is in one of the following states: • CLEAN • READY • STOPPED • ERRORHALT The firmware cannot be updated while the controller is in RUNNING state or ONLINE CHANGE state. **NOTE:** EcoStruxure Automation Device Maintenance notifies you to stop the M251 distributed PAC if it is in the RUNNING state before starting the firmware update. Go to the **Notification** area to stop the controller.

Updating the Firmware

EcoStruxure Automation Device Maintenance allows you to update the firmware of devices displayed in the **Device/Loading** tab.

The following table describes how to update the firmware:

Step	Action
1	In EcoStruxure Automation Device Maintenance, access the **Device/Loading** tab.
2	**2a**. To update a single device, click the **Update Center** icon in the row of the device. **2b**. To update several devices simultaneously, select the check boxes of the devices, or select the check box of the entire **Group**, and click the **Update Center** button  from the button bar.
3	In the **Update Center** dialog box, click the **Firmware** button.
4	**4a**. To update a single device, in the **Firmware** dialog box, select the device and the target firmware data package. **4b**. To update several devices simultaneously, in the **Firmware** dialog box, select the devices and the target firmware data package(s).
5	Click **Save** to save the firmware update configuration and to close the **Firmware** dialog box. **Result**: In the **Update Info** cell(s) of the device(s) of the **Device/Loading** tab, the blue **i** icon is displayed indicating as tooltip: **Selected for update** **Firmware: [(target firmware version) firmware package name]**
6	Click the **Update** button from the bottom of the **Device/Loading** tab to start the update process. **Result**: The **Update Confirmation** dialog box is displayed with stage **1 Select a Category**.
7	Select the option **Firmware** and click **Next**. **Result**: The stage **2 Prerequisite** dialog box opens.
8	The stage **2 Prerequisite** dialog box displays the firmware data package(s) that have been selected for update, showing that they are locally available on your PC. If package(s) are only available on the remote repository, they are provided in a list. Select the entries in the list and click the **Download** button to download the package(s) to your local PC. After successful download, or if the list is empty, click **Next** to open stage **3 Review the Selection**.
9	In the stage **3 Review the Selection** dialog box, carefully review the list of devices selected for firmware update and verify the settings you chose. Then click **Next**. **Result**: The stage **4 Confirmation** dialog box opens.
10	Before you start the update procedure, stage **4 Confirmation** allows you to disable notification messages throughout the update process by selecting a confirmation check box. If the system is running in maintenance mode, this setting prevents the process from being paused. **⚠WARNING** **UNANTICIPATED EQUIPMENT OPERATION** Do not disable notifications if you are not fully trained in the practice of firmware update and the consequences on the equipment. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Step	Action
11	Click the **Confirm** button to return to the **Device/Loading** tab and to start the update process. If you have not suppressed the notifications during stage **4 Confirmation**, the process is paused and a message is displayed in the **Notification** area whenever an interaction is required. Carefully read each message and confirm or cancel after you have evaluated the risks. After you have confirmed each message, the process will resume. For details on **Notification** area, refer to the EcoStruxure Automation Expert Online Help.
12	After the update process is completed, the result is displayed in the **Update Info** cell of each device that has been updated. For further information: • Refer to the **Logs** window. • Click the **Summary** button from the bottom of the EcoStruxure Automation Device Maintenance to display the **Update Summary** dialog box. It provides information on the status of the update for each device indicating the previous and the target firmware or security configuration file version, as well as the data package(s).

NOTICE

INOPERABLE EQUIPMENT

Do not turn off the PC or close the application and make sure that the PC does not enter sleep mode during the update firmware process.

Failure to follow these instructions can result in equipment damage.

After successfully completing the firmware process for the controller, the device starts in the CLEAN state.

Before using electrical control and automation equipment for regular operation after a firmware update, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check are made and that enough time is allowed to perform complete and satisfactory testing.

⚠WARNING

EQUIPMENT OPERATION HAZARD

- Verify that all firmware update procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means from all component devices.
- Remove tools, meters, and debris from equipment.

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

Follow all start-up tests recommended in the equipment documentation.

Software testing must be done in both simulated and real environments.

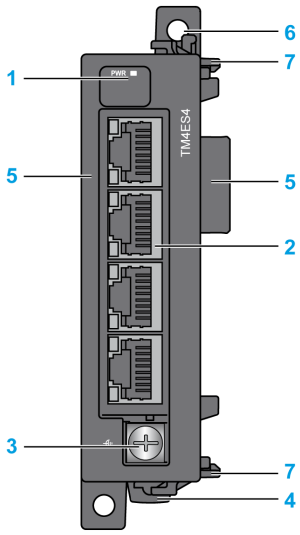
TM4ES4 Ethernet Module

TM4ES4 Presentation

Overview

The TM4ES4 Ethernet module provides additional Ethernet ports to the M251 distributed PAC, and acts as an Ethernet independent switch only. The TM4ES4 is used as switch without internal communication with the controller.

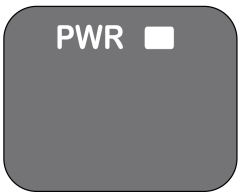
The following figure shows the main elements of the TM4ES4 module:



Label	Description	Refer to
1	LED that displays the power supply status	–
2	4 Ethernet RJ45 connectors	–
3	Screw for functional ground connection	Rules for the Connection to the Functional Ground, page 49
4	Clip-on lock for 35 mm (1.38 in.) top hat section rail (DIN-rail)	Top Hat Section Rail (DIN rail), page 40
5	Connector for TM4 expansion modules (one on each side)	–
6	Locking device for attachment to the previous module	–
7	Clip for attachment to the previous module or the controller	–

Module Power LED

The figure shows the TM4ES4 **PWR** LED:

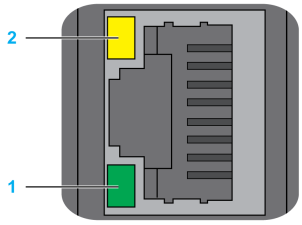


The table shows the description the TM4ES4 **PWR** LED:

LED	Color	Status	Description
PWR	Green	On	Indicates that power is applied
		Off	Indicates that power is removed

RJ45 Connector Status LEDs

The figure shows the RJ45 connector status LEDs:



The table describes the RJ45 connector status LEDs:

Label	Description	LED		
		Color	Status	Description
1	Ethernet activity	Green	Off	No activity and no link
			On	The link is detected, but there is no activity
			Flashing	Transmitting or receiving data
2	Ethernet link/ speed	Green/ Yellow	Off	No link
			Solid yellow	Link at 10 Mbps
			Solid green	Link at 100 Mbps

TM4ES4 Characteristics

Introduction

These are the general characteristics of the TM4ES4 module.

See also Environmental Characteristics, page 33.

⚠WARNING

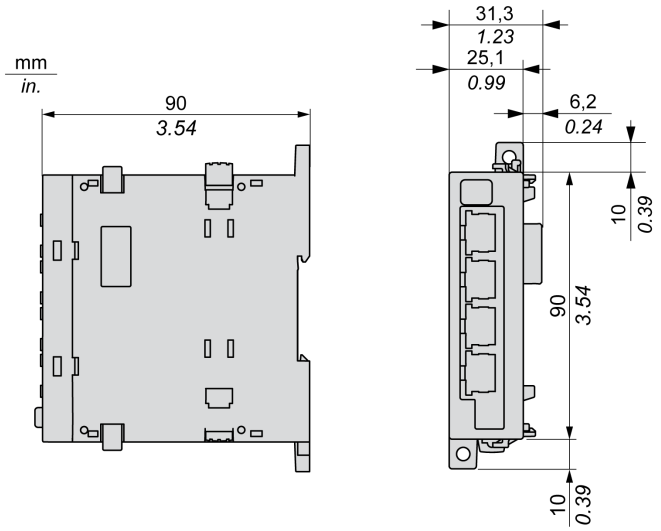
UNINTENDED EQUIPMENT OPERATION

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

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

Dimensions

The following diagram shows the dimensions of the TM4ES4 module:



General Characteristics

The table describes the general characteristics of the TM4ES4 module:

Characteristic	Value
Consumption	360 mA
Power dissipation	2.5 W
Weight	125 g (4.41 oz)

Communication Port Characteristics

The table describes the communication port characteristics of the TM4ES4 module:

Characteristic	Description
Standard	Ethernet
Connector type	RJ45
Baud rate	Supports Ethernet "10BaseT" and "100BaseTX" with auto-negotiation
Auto-crossover	MDI / MDIX

NOTE: The controller supports the MDI/MDIX auto-crossover cable function. It is not necessary to use special Ethernet crossover cables to connect devices directly to this port (connections without an Ethernet hub or switch).

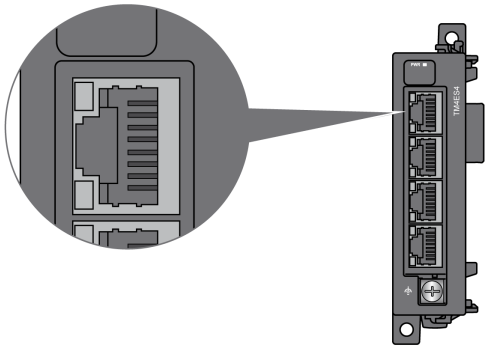
TM4ES4 Wiring Diagram

Wiring Rules

See Wiring Best Practices, page 45.

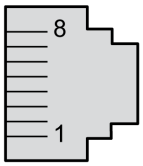
RJ45 Connector

The TM4ES4 module is equipped with 4 Ethernet RJ45 connectors:



Pin Assignment

The figure shows the Ethernet RJ45 connector pins:

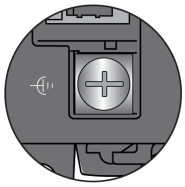


The table describes the Ethernet RJ45 connector pins assignment:

Pin N°	Signal
1	TD+
2	TD-
3	RD+
4	–
5	–
6	RD-
7	–
8	–

Rules for Connection to the Functional Ground

The following table shows the characteristics of the screw to be used with the provided Functional Earth (FE) Cable:



Phillips Ph2	C	N•m	0,5
		lb-in	*4.4*

Applying torque above the limit may damage the terminal screw or threads.

NOTICE
INOPERABLE EQUIPMENT Do not tighten screw terminals beyond the specified maximum torque (Nm / lb-in.). **Failure to follow these instructions can result in equipment damage.**

Glossary

A

application:

A program including configuration data, symbols, and documentation.

B

bps:

(*bit per second*) A definition of transmission rate, also given in conjunction with multiplicator kilo (kbps) and mega (mbps).

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

DIN:

(*Deutsches Institut für Normung*) A German institution that sets engineering and dimensional standards.

E

EIA rack:

(*electronic industries alliance rack*) A standardized (EIA 310-D, IEC 60297, and DIN 41494 SC48D) system for mounting various electronic modules in a stack or rack that is 19 inches (482.6 mm) wide.

EN:

EN identifies one of many European standards maintained by CEN (*European Committee for Standardization*), CENELEC (*European Committee for Electrotechnical Standardization*), or ETSI (*European Telecommunications Standards Institute*).

F

FE:

(functional Earth) A common grounding connection to enhance or otherwise allow normal operation of electrically sensitive equipment (also referred to as functional ground in North America).

In contrast to a protective Earth (protective ground), a functional earth connection serves a purpose other than shock protection, and may normally carry current. Examples of devices that use functional earth connections include surge suppressors and electromagnetic interference filters, certain antennas, and measurement instruments.

H

HE10:

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

I

IEC:

(*international electrotechnical commission*) A non-profit and non-governmental international standards organization that prepares and publishes international standards for electrical, electronic, and related technologies.

I/O:

(*input/output*)

IP 20:

(*ingress protection*) The protection classification according to IEC 60529 offered by an enclosure, shown by the letter IP and 2 digits. The first digit indicates 2 factors: helping protect persons and for equipment. The second digit indicates helping protect against water. IP 20 devices help protect against electric contact of objects larger than 12.5 mm, but not against water.

L

LED:

(*light emitting diode*) An indicator that illuminates under a low-level electrical charge.

M

Modbus:

The protocol that allows communications between many devices connected to the same network.

N

NEMA:

(*national electrical manufacturers association*) The standard for the performance of various classes of electrical enclosures. The NEMA standards cover corrosion resistance, ability to help protect from rain, submersion, and so on. For IEC member countries, the IEC 60529 standard classifies the ingress protection rating for enclosures.

P

PE:

(*Protective Earth*) A common grounding connection to help avoid the hazard of electric shock by keeping any exposed conductive surface of a device at earth potential. To avoid possible voltage drop, no current is allowed to flow in this conductor (also referred to as *protective ground* in North America or as an equipment grounding conductor in the US national electrical code).

program:

The component of an application that consists of compiled source code capable of being installed in the memory of a logic controller.

R

RJ45:

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

RS-485:

A standard type of serial communication bus, based on 2 wires (also known as EIA RS-485).

RTC:

real-time clock A battery-backed time-of-day and calender clock that operates continuously, even when the controller is not powered for the life of the battery.

RxD:

The line that receives data from one source to another.

T

terminal block:

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

TxD:

The line that sends data from one source to another.

Index

Schneider Electric
35 rue Joseph Monier
92500 Rueil Malmaison
France

+ 33 (0) 1 41 29 70 00

www.se.com

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

EIO0000004089.05