Modicon TM3

Analog I/O Modules Hardware Guide

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The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, 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 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 an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

PLEASE NOTE

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

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

About the Book

At a Glance

Document Scope

This guide describes the hardware implementation of TM3 analog I/O expansion modules. It provides the description, characteristics, wiring diagrams, and installation details for TM3 analog I/O expansion modules.

Validity Note

This document has been updated with the release of SoMachine V4.1.

This document has been updated with the release of SoMachine Basic V1.1.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to the Schneider Electric home page *www.schneider-electric.com*.
2	In the **Search** box type the reference of a product or the name of a product range. ● Do not include blank spaces in the model number/product range. ● To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the **Product datasheets** search results and click on the reference that interests you. If you entered the name of a product range, go to the **Product Ranges** search results and click on the product range that interests you.
4	If more than one reference appears in the **Products** search results, click on the reference that interests you.
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click **Download XXX product datasheet**.

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

Related Documents

Title of Documentation	Reference Number
Modicon TM3 Expansion Modules Configuration - Programming Guide (SoMachine Basic)	EIO0000001396 (ENG) EIO0000001397 (FRA) EIO0000001398 (GER) EIO0000001399 (SPA) EIO0000001400 (ITA) EIO0000001401 (CHS) EIO0000001374 (POR) EIO0000001375 (TUR)
Modicon TM3 Expansion Modules Configuration - Programming Guide (SoMachine)	EIO0000001402 (ENG) EIO0000001403 (FRA) EIO0000001404 (GER) EIO0000001405 (SPA) EIO0000001406 (ITA) EIO0000001407 (CHS)
Modicon M221 Logic Controller - Hardware Guide	EIO0000001384 (ENG) EIO0000001385 (FRA) EIO0000001386 (GER) EIO0000001387 (SPA) EIO0000001388 (ITA) EIO0000001389 (CHS) EIO0000001370 (POR) EIO0000001371 (TUR)
Modicon M241 Logic Controller - Hardware Guide	EIO0000001456 (ENG) EIO0000001457 (FRA) EIO0000001458 (GER) EIO0000001459 (SPA) EIO0000001460 (ITA) EIO0000001461 (CHS)
Modicon M251 Logic Controller - Hardware Guide	EIO0000001486 (ENG) EIO0000001487 (FRA) EIO0000001488 (GER) EIO0000001489 (SPA) EIO0000001490 (ITA) EIO0000001491 (CHS)
TM3 Analog I/O Modules Instruction Sheet	HRB59605

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

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.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

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

⚠ WARNING

LOSS OF CONTROL

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

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

[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.

Part I
TM3 General Overview

What Is in This Part?

This part contains the following chapters:

Chapter 1
TM3 Description

What Is in This Chapter?

This chapter contains the following topics:

General Description

Introduction

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

- Input modules
- Output modules
- Mixed input/output modules

All TM3 analog I/O expansion modules are equipped with (depending on the reference):

- Removable screw terminal blocks
- Removable spring terminal blocks

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 *(see page 44)*	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 *(see page 44)*	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 *(see page 50)*	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 *(see page 50)*	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 *(see page 58)*	12 bit, or 11 bit + sign	8	inputs	0...10 Vdc -10…+10 Vdc 0...20 mA 4...20 mA	Removable screw terminal block / 3.81 mm
TM3AI8G *(see page 58)*	12 bit, or 11 bit + sign	8	inputs	0...10 Vdc -10…+10 Vdc 0...20 mA 4...20 mA	Removable spring terminal blocks / 3.81 mm

Reference	Resolution	Channels	Channel Type	Mode	Terminal Type / Pitch
TM3TI4 *(see page 66)*	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
TM3TI4G *(see page 66)*	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
TM3TI8T *(see page 74)*	16 bit, or 15 bit + sign	8	inputs	Thermocouple NTC/PTC	Removable screw terminal block / 3.81 mm
TM3TI8TG *(see page 74)*	16 bit, or 15 bit + sign	8	inputs	Thermocouple NTC/PTC	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 *(see page 84)*	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 *(see page 84)*	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 *(see page 90)*	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 *(see page 90)*	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 *(see page 98)*	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		
TM3AM6G *(see page 98)*	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 *(see page 106)*	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	output	0...10 Vdc -10...+10 Vdc 0...20 mA 4...20 mA	
TM3TM3G *(see page 106)*	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	output	0...10 Vdc -10...+10 Vdc 0...20 mA 4...20 mA	

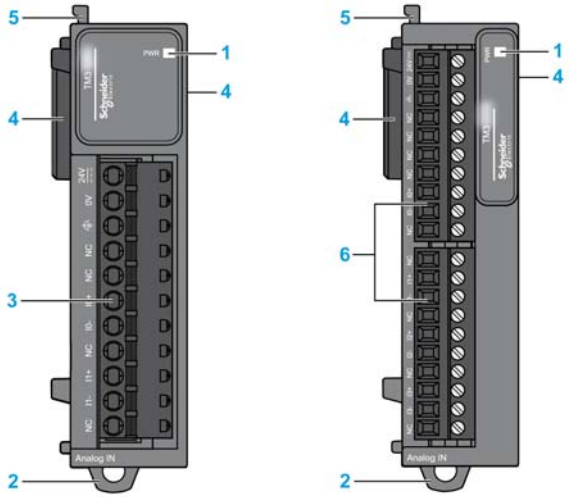
Physical Description

Introduction

This section describes the physical characteristics of the TM3 modules. The modules, depending on the reference, support removable screw or spring terminal block.

TM3 with Removable Screw or Spring Terminal Block

The following figure shows the main elements of a TM3 expansion module with removable screw or spring terminal block:



This table describes the main elements of the TM3 expansion modules shown above:

Label	Elements	
1	Power supply LED.	
2	Clip-on lock for 35 mm (1.38 in.) top hat section rail (DIN-rail).	DIN Rail *(see page 32)*
3	Removable terminal block.	Rules for Removable Screw Terminal Block *(see page 39)*
4	Expansion connector for TM3 I/O bus (one on each side).	
5	Locking device for attachment to the previous module.	
6	Removable terminal block.	Rules for Removable Spring Terminal Block *(see page 40)*

Accessories

Overview

This section describes the accessories and cables.

Accessories

Reference	Description	Use	Quantity
TMAT2MSET	Set of 5 removable screw terminal block	Connects the module I/Os.	1
TMAT2MSETG	Set of 5 removable spring terminal block	Connects the module I/Os.	1
AB1AB8P35	End brackets	Help secure the logic controller or receiver module and their expansion modules on a top hat section rail (DIN rail).	1
TM2XMTGB	Grounding Bar	Connects the cable shield and the module to the functional ground.	1
TM200RSRCEMC	Shielding take-up clip	Mounts and connects the ground to the cable shielding.	25 pack
TMAM2	Mounting Kit	Mounts the controller and I/O modules directly to a flat, vertical panel.	1

Cables

Chapter 2
TM3 Installation

What Is in This Chapter?

This chapter contains the following sections:

Section 2.1
TM3 General Rules for Implementing

What Is in This Section?

This section contains the following topics:

Environmental Characteristics

Enclosure Requirements

TM3 expansion module 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 these standards, 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.

All TM3 expansion module 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 TM3 expansion module components. Use enclosures with a keyed locking mechanism to minimize unauthorized access.

Environmental Characteristics

All the TM3 expansion module components are electrically isolated between the internal electronic circuit and the input/output channels. 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		Specification
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

Characteristic		Specification
Degree of protection	IEC/EN 61131-2	IP20
Machine Safety conformance	IEC/EN 61010-2-201	Yes
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...8.5 Hz 29.4 m/s^2 or 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

Electromagnetic Susceptibility

The TM3 expansion module components meets electromagnetic susceptibility specifications as indicated in the following table:

Characteristic	Designed to specification	Range	
Electrostatic discharge	IEC/EN 61000-4-2	8 kV (air discharge) 4 kV (contact discharge)	
Radiated electromagnetic field	IEC/EN 61000-4-3	10 V/m (80...1000 MHz) 3 V/m (1.4...2 GHz) 1 V/m (2...3 GHz)	
Magnetic field	IEC/EN 61000-4-8	30 A/m 50 Hz, 60 Hz	
Fast transients burst	IEC/EN 61000-4-4	–	CM[1] and DM[2]
		AC/DC Power lines	–
		Relay Outputs	–
		24 Vdc I/Os	–
		Analog I/Os	1 kV
		Communication line	–

Characteristic	Designed to specification	Range		
Surge immunity	IEC/EN 61000-4-5 IEC/EN 61131-2	–	CM[1]	DM[2]
		DC Power lines	1 kV	0.5 kV
		AC Power lines	–	–
		Relay Outputs	–	–
		24 Vdc I/Os	1 kV	–
		Shielded cable (between shield and ground)	–	
Induced electromagnetic field	IEC/EN 61000-4-6	10 Vrms (0.15...80 MHz)		
Conducted emission	IEC/EN 55011 (IEC/CISPR Publication 11)	AC power line: ● 0.15...0.5 MHz: 79 dBµV/m QP / 66 dBµV/m AV ● 0.5...300 MHz: 73 dBµV/m QP / 60 dBµV/m AV		
		AC/DC power line: ● 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/EN 55011 (IEC/CISPR Publication 11)	Class A, 10 m distance: ● 30...230 MHz: 40 dBµV/m QP ● 230...1000 MHz: 47 dBµV/m QP		

1 Common Mode

2 Differential Mode

Certifications and Standards

Introduction

The TM3 expansion modules are designed to conform to the main national and international standards concerning electronic industrial control devices:

- IEC/EN 61131-2
- UL 508

The TM3 have obtained, or in the process of obtaining, the following conformity marks:

- CE
- cULus Listing Mark
- C-Tick

The TM3 expansion modules comply with the main national and international Directives and Regulations concerning electronic industrial control devices:

- Europe RoHS:
  - Exemption annex III 7(a)
  - Exemption annex III 7(c)-I
  - Exemption annex III 34
- China RoHS regulations 
- REACh v9

Section 2.2
TM3 Expansion Module Installation

What Is in This Section?

This section contains the following topics:

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

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

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.
- 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.
- Do not disassemble, repair, or modify this equipment.
- Do not connect any wiring to reserved, unused connections, or to connections designated as No Connection (N.C.).

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

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

Installation Guidelines

Introduction

TM3 expansion modules are assembled by connecting them to a logic controller or receiver module.

The logic controller or receiver module and their expansion modules can be installed on a top hat section rail (DIN rail).

Mounting Position and Minimum Clearances

The mounting position and minimum clearances of the expansion modules must conform with the rules defined for the appropriate hardware system. Refer to the *Installation chapter* in the *Controller Hardware* documentation for your specific controller.

⚠ 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.

Assembling a Module to a Controller or Receiver Module

Introduction

This section describes how to assemble an expansion module to a controller, Receiver module or other modules.

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.

After connecting new modules to the controller, either directly or through a transmitter/receiver, update and redownload your application program before placing the system back in service. If you do not revise your application program to reflect the addition of new modules, I/O located on the expansion bus may no longer operate normally.

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.

Assembling a Module to a Controller or Receiver Module

The following procedure shows how to assemble a controller or receiver module and a module together.

Step	Action
1	Remove all power and dismount any existing controller I/O assembly from its DIN mounting.
2	Remove the expansion connector sticker from the controller or the outermost installed expansion module.
3	Verify that the locking device on the new module is in the upper position.
4	Align the internal bus connector on the left side of the module with the internal bus connector on the right side of the controller, Receiver module or expansion module.
5	Press the new module towards the controller, Receiver module or expansion module until it is securely in place.
6	Push down the locking device on the top of the new module to lock it to the controller, Receiver module or previously installed expansion module.

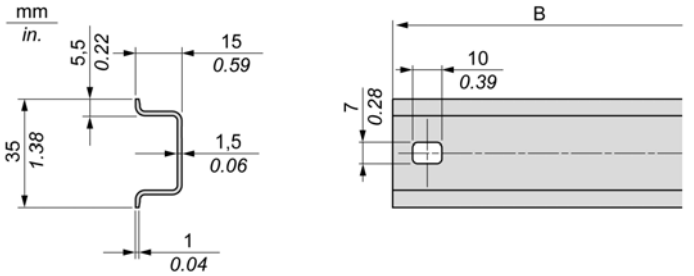
Top Hat Section Rail (DIN rail)

Dimensions of Top Hat Section Rail DIN Rail

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

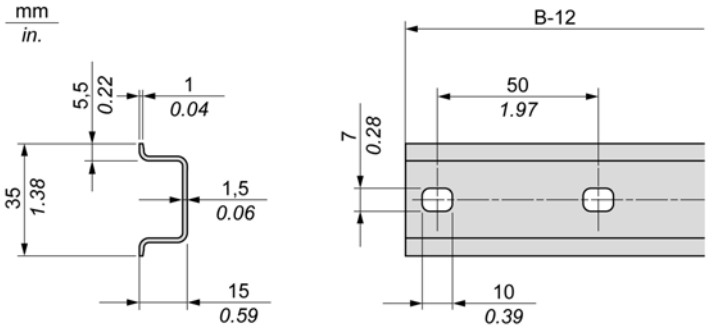
Symmetric Top Hat Section Rails (DIN Rail)

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



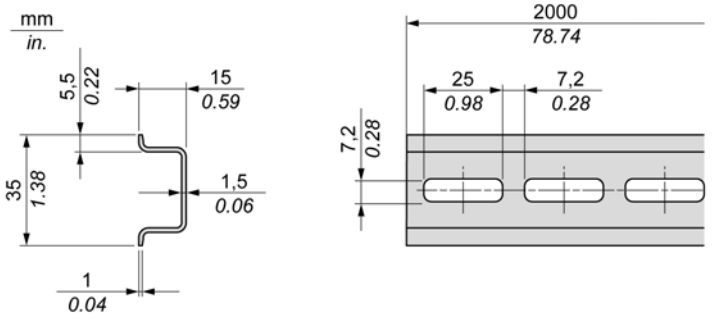
Reference	Type	Rail Length (B)
NSYSDR50A	A	450 mm (17.71 in.)
NSYSDR60A	A	550 mm (21.65 in.)
NSYSDR80A	A	750 mm (29.52 in.)
NSYSDR100A	A	950 mm (37.40 in.)

The following illustration and table show 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.)

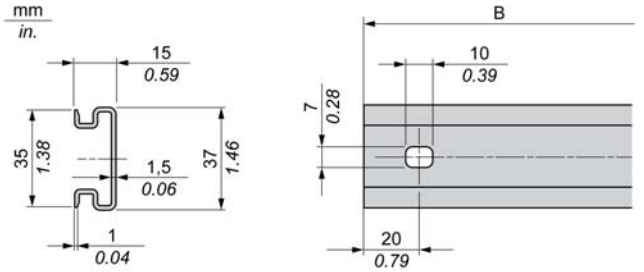
The following illustration and table shows the references of the symmetric top hat section rails (DIN rail) of 2000 mm (78.74 in.):



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

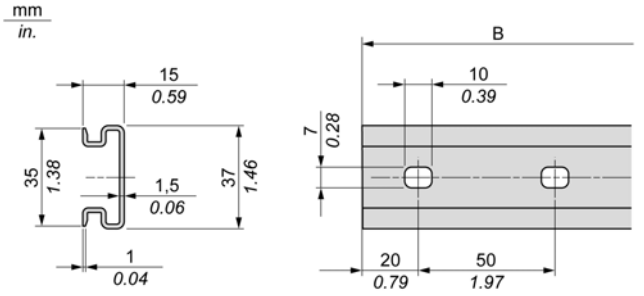
Double-Profile Top Hat Section Rails (DIN rail)

The following illustration and table show 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 show 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.)

Disassembling a Module from a Controller or Receiver Module

Introduction

This section describes how to disassemble a module from a controller or receiver module.

⚠⚠ 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.

Disassembling a Module from a Controller or Receiver Module

The following procedure describes how to disassemble a module from a controller or receiver module.

Step	Action
1	Remove all power from the control system.
2	Dismount the assembled controller and modules from the mounting rail.
3	Push up the locking device *(see page 17)* from the bottom of the module to disengage it from the controller or receiver module.
4	Pull apart module from the controller or receiver module.

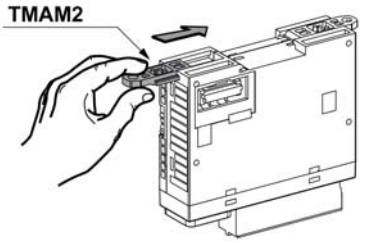
Direct Mounting on a Panel Surface

Overview

This section shows how to install TM3 expansion module using the Panel Mounting Kit. This section also provides mounting hole layout for all modules.

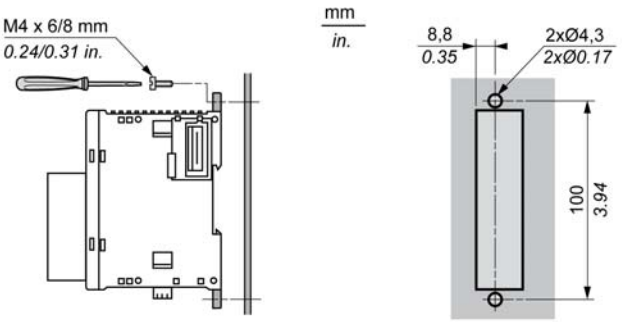
Installing the Panel Mount Kit

The following procedure shows how to install a mounting strip:

Step	Action
1	Insert the mounting strip TMAM2 into the slot at the top of the module. 

Mounting Hole Layout

The following diagram shows the mounting holes for TM3 with 2, 4 and 8 screw or spring I/Os channels:



Section 2.3
TM3 Electrical Requirements

Wiring Best Practices

Overview

This section describes the wiring guidelines and associated best practices to be respected when using the TM3 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

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

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

[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.

Functional Ground (FE) on the DIN Rail

The DIN Rail for your TM3 system is common with the functional ground (FE) plane and must be mounted on a conductive backplane.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Connect the DIN rail to the functional ground (FE) of your installation.

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

Protective Ground (PE) on the Backplane

The protective ground (PE) is connected to the conductive backplane by a heavyduty wire, usually a braided copper cable with the maximum allowable cable section.

Wiring Guidelines

The following rules must be applied when wiring a TM3 system:

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Use shielded cables for all fast I/O, analog I/O, and communication signals.
- Ground cable shields for all fast I/O, analog I/O, and communication signals at a single point[1].
- Route communications and I/O cables 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.

NOTE: Surface temperatures may exceed 60° C. 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 **3.81 pitch** removable screw terminal block (I/Os and power supply):

mm / in. 9 / 0.35								
mm²	0.14…1.5	0.14…1.5	0.25…1.5	0.25…0.5	2 x 0.14…0.5	2 x 0.14…0.75	2 x 0.25…0.34	2 x 0.5
AWG	25…16	25…16	23...16	23...20	2 x 25…20	2 x 25…19	2 x 24…22	2 x 20

Ø 2,5 mm (0.1 in.)		N•m	0.22...0.25
		lb-in	1.95...2.21

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

mm / in. 7 / 0.28								
mm²	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.)		N•m	0.5...0.6
		lb-in	4.42...5.31

The use of copper conductors is required.

⚠ DANGER

FIRE HAZARD

- Use only the recommended wire sizes for the current capacity of the I/O channels and power supplies.
- For relay output (2 A) wiring, use conductors of at least 0.5 mm2 (AWG 20) with a temperature rating of at least 80 °C (176 °F).
- For common conductors of relay output wiring (7 A), or relay output wiring greater than 2 A, use conductors of at least 1.0 mm2 (AWG 16) with a temperature rating of at least 80 °C (176 °F).

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

Rules for Removable Spring Terminal Block

The following tables show the cable types and wire sizes for a **3.81 pitch** removable spring terminal block (I/Os and power supply):

mm / in. 9 / 0.35				
mm^2	0.2…1.5	0.2…1.5	0.25…1.5	0.25…0.75
AWG	24…16	24…16	23...16	23...19

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

mm / in. 10 / 0.39					
mm^2	0.2…2.5	0.2…2.5	0.25…2.5	0.25…2.5	2 x 0.5...1
AWG	24…14	24…14	23...14	23...14	2 x 20...17

The use of copper conductors is required.

⚠ DANGER

FIRE HAZARD

- Use only the recommended wire sizes for the current capacity of the I/O channels and power supplies.
- For relay output (2 A) wiring, use conductors of at least 0.5 mm2 (AWG 20) with a temperature rating of at least 80 °C (176 °F).
- For common conductors of relay output wiring (7 A), or relay output wiring greater than 2 A, use conductors of at least 1.0 mm2 (AWG 16) with a temperature rating of at least 80 °C (176 °F).

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

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

⚠ DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

Do not insert more than one wire per connector of the terminal block without a double wire cable end.

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

Part II
TM3 Analog Input Modules

What Is in This Part?

This part contains the following chapters:

Chapter 3
TM3AI2H / TM3AI2HG Module 2 Inputs 24 Vdc

Overview

This chapter describes the TM3AI2H / TM3AI2HG expansion modules, its characteristics, and its connection to the different sensors.

What Is in This Chapter?

This chapter contains the following topics:

TM3AI2H / TM3AI2HG Presentation

Overview

TM3AI2H (screw) and TM3AI2HG (spring) analog expansion modules:

- 2 channels 16 bits (Voltage, current)
- Removable screw and spring terminal block

Main Characteristics

Characteristic		Value	
Number of input channels		2 inputs	
Rated power supply		24 Vdc	
Signal type		Voltage	Current
Input range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Resolution		16 bits, or 15 bits + sign	
Connection type	TM3AI2H	Removable screw terminal block	
	TM3AI2HG	Removable spring terminal block	
Cable type and length	Type	Twisted pair shielded	
	Length	Max. 30 m (98 ft)	
Weight	TM3AI2H	115 g (4.05 oz)	
	TM3AI2HG	100 g (3.52 oz)	

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3AI2H / TM3AI2HG Characteristics

Introduction

This section provides a general description of the characteristics of the TM3AI2H / TM3AI2HG expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

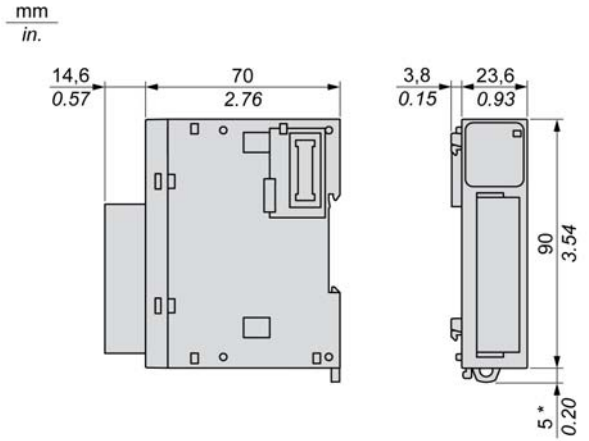
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3AI2H / TM3AI2HG expansion modules:



NOTE: *8.5 mm (0.33 in.) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	30 mA (no load) 40 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	25 mA (no load) 25 mA (full load)

Input Characteristics

The following table describes the input characteristics of the TM3AI2H / TM3AI2HG expansion modules:

Characteristics	Value	
	Voltage input	**Current input**
Input range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Input impedance	1 MΩ min	50 Ω max
Sample duration time	1 ms per enabled channel	
Input type	Single-ended input	
Operating mode	Self-scan	
Conversion mode	Sigma delta ADC	
Max accuracy at ambient 25 °C (77 °F)	±0.1 % of full scale	
Temperature drift	±0.006 % of full scale	
Repeatability after stabilization time	±0.5 % of full scale	
Nonlinearity	±0.01 % of full scale	
Maximum input deviation	±1.0 % of full scale	
Resolution	16 bits, or 15 bits + sign (65536 points)	
Input value of LSB	2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program	Scalable from –32768 to 32767	
Input data out of range detection	Yes	

Characteristics		Value	
		Voltage input	**Current input**
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable, max 30 m	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Maximum continuous allowed overload (no damage)		13 Vdc	40 mA
Input filter		Software filter: 0...10 s (per 0.01 s unit)	
Behavior when external power is off		Input value is 0 The External power supply error status bit in the controller is ON.	

TM3AI2H / TM3AI2HG Wiring Diagram

Introduction

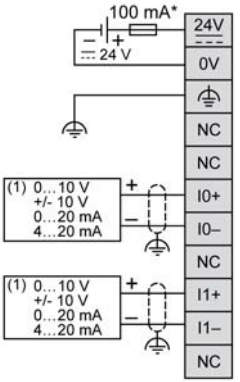
This expansion module has a built-in removable screw terminal block for the connection of inputs and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connection between the inputs, the sensors, and their commons:



***** Type T fuse

(1) Current/Voltage analog output device

⚠ 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.

Chapter 4
TM3AI4 / TM3AI4G Module 4 Inputs 24 Vdc

Overview

This chapter describes the TM3AI4 / TM3AI4G expansion modules, its characteristics, and its connection to the different sensors.

What Is in This Chapter?

This chapter contains the following topics:

TM3AI4 / TM3AI4G Presentation

Overview

TM3AI4 (screw) and TM3AI4G (spring) analog expansion modules:

- 4 channels 12 bits (Voltage, current)
- Removable screw or spring terminal block

Main Characteristics

Characteristic		Value	
Number of input channels		4 inputs	
Rated power supply		24 Vdc	
Signal type		Voltage	Current
Input range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Resolution		12 bits, or 11 bits + sign	
Connection type	TM3AI4	Removable screw terminal block	
	TM3AI4G	Removable spring terminal block	
Cable type and length	Type	Twisted pair shielded	
	Length	Max. 30 m (98 ft)	
Weight	TM3AI4	110 g (4.05 oz)	
	TM3AI4G	100 g (3.52 oz)	

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3AI4 / TM3AI4G Characteristics

Introduction

This section describes the general characteristics of the TM3AI4 / TM3AI4G expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

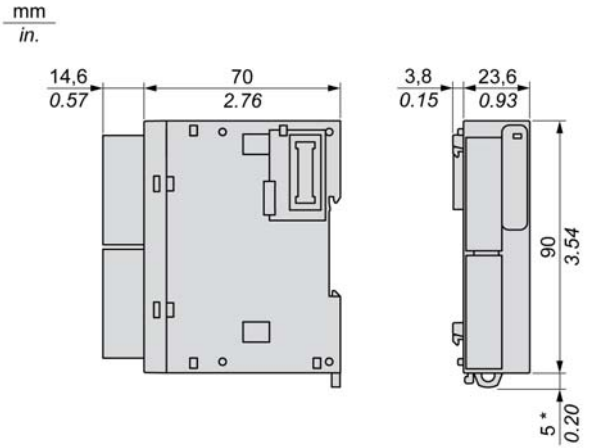
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3AI4 / TM3AI4G expansion modules:



NOTE: * 8.5 mm (0.33 in.) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	35 mA (no load) 45 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	30 mA (no load) 30 mA (full load)

Input Characteristics

The following table describes the input characteristics of the TM3AI4 / TM3AI4G expansion modules:

Characteristics	Value	
	Voltage input	**Current input**
Input range	0...10 Vdc –10…+10 Vdc	0...20 mA 4...20 mA
Input impedance	1 MΩ min	50 Ω max
Sample duration time	1 ms per enabled channel	
Input type	Single-ended input	
Operating mode	Self-scan	
Conversion mode	Sigma delta ADC	
Max accuracy at ambient 25 °C (77 °F)	±0.2 % of full scale	
Temperature drift	±0.01 % of full scale	
Repeatability after stabilization time	±0.5 % of full scale	
Nonlinearity	±0.2 % of full scale	
Maximum input deviation	±1.0 % of full scale	
Resolution	12 bits, or 11 bits + sign (4096 points)	
Input value of LSB	2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program	Scalable from –32768 to 32767	
Input data out of range detection	Yes	

Characteristics		**Value**	
		Voltage input	**Current input**
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable, max 30 m	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Maximum continuous allowed overload (no damage)		13 Vdc	40 mA
Input filter		Software filter: 0...10 s (per 0.01 s unit)	
Behavior when external power is off		Input value is 0 The External power supply error status bit in the controller is ON.	

TM3AI4 / TM3AI4G Wiring Diagram

Introduction

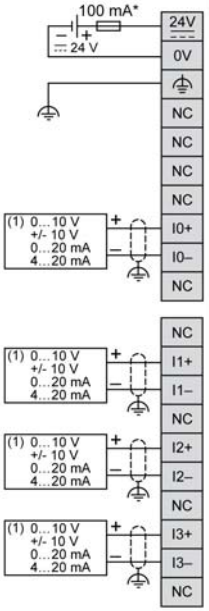
These expansion modules have a built-in removable screw or spring terminal block for the connection of inputs and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connection between the inputs, the sensors, and their commons:



***** Type T fuse

(1) Current/Voltage analog output device

⚠ 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.**

Chapter 5
TM3AI8 / TM3AI8G Module 8 Inputs 24 Vdc

Overview

This chapter describes the TM3AI8 / TM3AI8G expansion modules, its characteristics, and its connection to the different sensors.

What Is in This Chapter?

This chapter contains the following topics:

TM3AI8 / TM3AI8G Presentation

Overview

TM3AI8 (screw) and TM3AI8G (spring) analog expansion modules:

- 8 channels 12 bits (Voltage, current)
- Removable screw or spring terminal block

Main Characteristics

Characteristic		Value	
Number of input channels		8 inputs	
Rated power supply		24 Vdc	
Signal type		Voltage	Current
Input range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Resolution		12 bits, or 11 bits + sign	
Connection type	TM3AI8	Removable screw terminal block	
	TM3AI8G	Removable spring terminal block	
Cable type and length	Type	Twisted pair shielded	
	Length	Max. 30 m (98 ft)	
Weight	TM3AI8	110 g (3.88 oz)	
	TM3AI8G	100 g (3.52 oz)	

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3AI8 / TM3AI8G Characteristics

Introduction

This section provides a description of the input characteristics of TM3AI8 / TM3AI8G expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

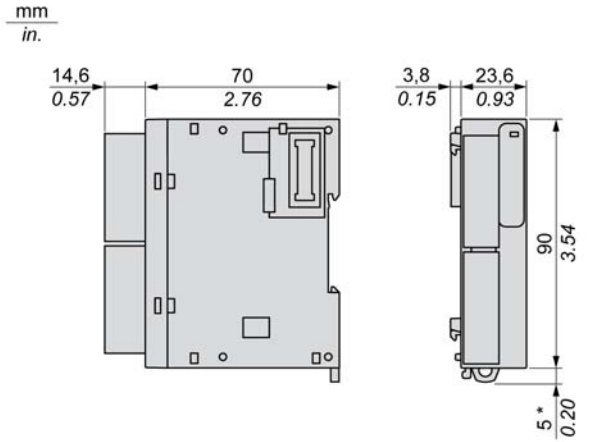
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3AI8 / TM3AI8G expansion modules:



NOTE: *8.5 mm (0.33 in.) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	35 mA (no load) 40 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	30 mA (no load) 40 mA (full load)

Input Characteristics

The following table describes the input characteristics of the TM3AI8 / TM3AI8G expansion modules:

Characteristics	Value	
	Voltage input	**Current input**
Input range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Input impedance	1 MΩ min	50 Ω max
Sample duration time	1 ms per enabled channel	
Input type	Single-ended input	
Operating mode	Self-scan	
Conversion mode	Sigma delta ADC	
Max accuracy at ambient 25 °C (77 °F)	±0.2 % of full scale	
Temperature drift	±0.01 % of full scale	
Repeatability after stabilization time	±0.5 % of full scale	
Nonlinearity	±0.2 % of full scale	
Maximum input deviation	±1.0 % of full scale	
Resolution	12 bits, or 11 bits + sign (4096 points)	
Input value of LSB	2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program	Scalable from –32768 to 32767	
Input data out of range detection	Yes	

Characteristics		Value	
		Voltage input	**Current input**
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable, max 30 m	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Maximum continuous allowed overload (no damage)		13 Vdc	40 mA
Input filter		Software filter: 0...10 s (per 0.01 s unit)	
Behavior when external power is off		Input value is 0 The External power supply error status bit in the controller is ON.	

TM3AI8 / TM3AI8G Wiring Diagrams

Introduction

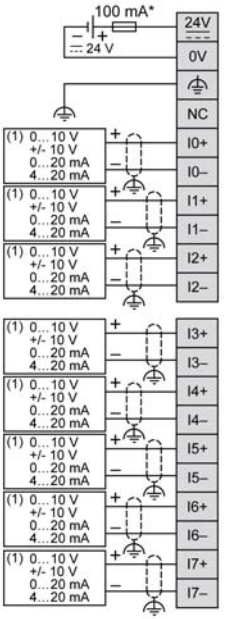
These expansion modules have a built-in removable screw or spring terminal block for the connection of inputs and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagrams

The following figure illustrates the connection between the inputs, the sensors, and their commons:



***** Type T fuse

(1) Current/Voltage analog output device

⚠ 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.

Chapter 6
TM3TI4 / TM3TI4G Module 4 Inputs 24 Vdc

Overview

This chapter describes the TM3TI4 / TM3TI4G expansion modules, its characteristics, and its connection to the different sensors.

What Is in This Chapter?

This chapter contains the following topics:

TM3TI4 / TM3TI4G Presentation

Overview

TM3TI4 (screw) and TM3TI4G (spring) analog expansion modules:

- 4 channels 16 bits (Voltage, current, thermocouple, 3-wire-RTD)
- Removable screw or spring terminal block

Main Characteristics

Characteristic	Value			
Number of input channels	4 inputs			
Rated power supply	24 Vdc			
Signal type	Voltage	Current	Thermocouple	3-wire-RTD
Input range	0…10 Vdc –10…+10 Vdc	0…20 mA 4…20 mA	Type K, J, R, S, B, E, T, N, C	PT100, PT1000, NI100, NI1000
Resolution max	16 bits, or 15 bits + sign (65536 points)			
Connection type	TM3TI4	Removable screw terminal block		
	TM3TI4G	Removable spring terminal block		
Cable type and length	Type	Twisted pair shielded		
	Length	Max. 30 m (98 ft)		
Weight	TM3TI4	110 g (3.88 oz)		
	TM3TI4G	100 g (3.52 oz)		

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3TI4 / TM3TI4G Characteristics

Introduction

This section provides a description of the input characteristics of TM3TI4 / TM3TI4G expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

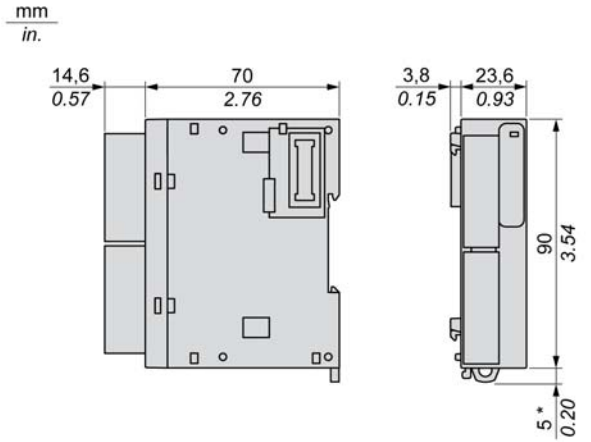
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3TI4 / TM3TI4G expansion modules:



NOTE: *8.5 mm (0.33 in.) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	45 mA (no load) 50 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	35 mA (no load) 40 mA (full load)

Input Characteristics

The following table describes the input characteristics of the TM3TI4 / TM3TI4G expansion modules:

Characteristics	Value					
	Voltage input	Current input	Thermocouple type		3-wire-RTD	
Input range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA	K	–200...1300 °C (–328...2372 °F)	PT100	–200...850 °C (–328...1562 °F)
			J	–200...1000 °C (–328...1832 °F)	PT1000	–200...600 °C (–328...1112 °F)
			R	0...1760 °C (32...3200 °F)	NI100	–60...180 °C (–76...356 °F)
			S	0...1760 °C (32...3200 °F)	NI 1000	–60...180 °C (–76...356 °F)
			B	0...1820 °C (32...3308 °F)	–	
			E	–200...800 °C (–328...1472 °F)		
			T	–200...400 °C (–328...752 °F)		
			N	–200...1300 °C (–328...1472 °F)		
			C	0...2315 °C (32...4199 °F)		
Input impedance	1 MΩ min	50 Ω max	1 MΩ min			
Sample duration time (software configurable)	10 ms or 100 ms per enabled channel		100 ms per enabled channel			

Characteristics	Value					
	Voltage input	Current input	Thermocouple type		3-wire-RTD	
Input type	Single-ended input					
Operating mode	Self-scan					
Conversion mode	Sigma delta ADC					
Max accuracy at ambient 25 °C (77 °F)	±0.2 % of full scale					
	–		Cold junction accuracy ±4.0 °C		–	
			except:			
			R S	±6 °C (0...200 °C)		
			B	Non-guaranted (0...300 °C)		
			K J E T N	±0.4 % of full scale under 0 °C		
Temperature drift	±0.01 % of full scale					
Repeatability after stabilization time	±0.5 % of full scale					
Nonlinearity	±0.2 % of full scale					
Maximum input deviation	±1.0 % of full scale					
Resolution	16 bits, or 15 bits + sign (65536 points)		K J R S B E T N C	15000 points 12000 points 17600 points 17600 points 18200 points 10000 points 6000 points 15000 points 23150 points	PT100 PT1000 NI100 NI1000	10500 points 8000 points 2400 points 2400 points
Input value of LSB	2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)	0.1 °C (0.18 °F)			
Data type in application program	Scalable from –32768 to 32767					

Characteristics		Value			
		Voltage input	**Current input**	**Thermocouple type**	**3-wire-RTD**
Input data out of range detection		Yes			
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring			
	Recommended cable	Twisted-pair shielded cable			
	Crosstalk	1 LSB max			
Isolation	Between external power supply and inputs	1500 Vac			
	Between inputs and internal logic circuits	5500 Vac			
Maximum continuous allowed overload (no damage)		13 Vdc	40 mA	N/A	
Input filter		Software filter: 0...10 s (per 0.01 s unit)			
Behavior when temperature sensor is broken		N/A		Input value is highest limit value Highest limit flag is ON	
Behavior when external power is off		Input value is 0		Input value is highest limit value	
		The External power supply error status bit in the controller is ON.			

TM3TI4 / TM3TI4G Wiring Diagram

Introduction

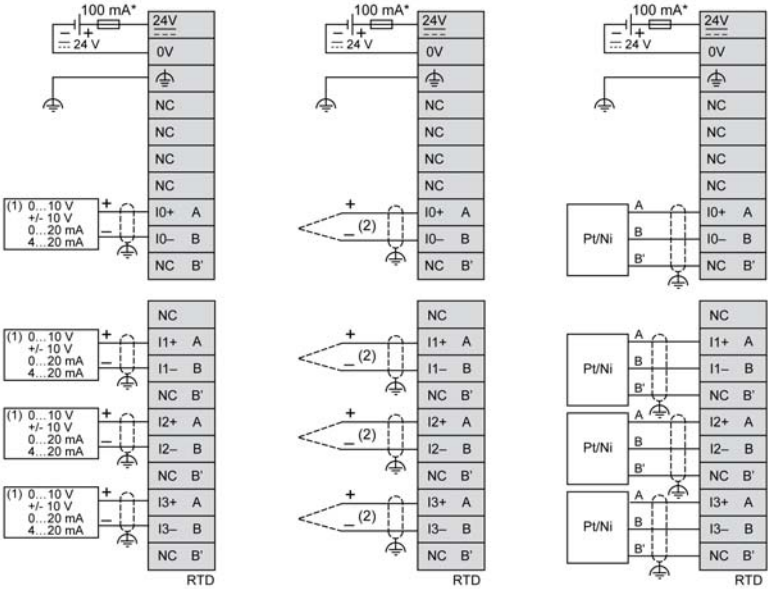
These expansion modules have a built-in removable screw or spring terminal block for the connection of inputs and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connection between the inputs, the sensors, and their commons:



***** Type T fuse
(1) Current/Voltage analog output device
(2) Thermocouple

⚠ 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.

Chapter 7
TM3TI8T / TM3TI8TG Module 8 Inputs 24 Vdc

Overview

This chapter describes the TM3TI8T / TM3TI8TG expansion modules, its characteristics, and its connection to the different sensors.

What Is in This Chapter?

This chapter contains the following topics:

TM3TI8T / TM3TI8TG Presentation

Overview

TM3TI8T (screw) and TM3TI8TG (spring) analog expansion modules:

- 8 channels 16 bits (thermocouple, thermistor)
- Removable screw or spring terminal block

Main Characteristics

Characteristic	Value		
Number of input channels	8 inputs		
Rated power supply	24 Vdc		
Signal type	Thermocouple		Thermistor
Input range	Type K, J, R, S, B, E, T, N, C		NTC, PTC
Resolution max	16 bits, or 15 bits + sign (65536 points)		
Connection type	TM3TI8T		Removable screw terminal block
	TM3TI8TG		Removable spring terminal block
Cable type and length	Type	Twisted pair shielded	
	Length	Max. 30 m (98 ft)	
Weight	TM3TI8T		110 g (3.88 oz)
	TM3TI8TG		100 g (3.52 oz)

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3TI8T / TM3TI8TG Characteristics

Introduction

This section provides a description of the electrical and input/output characteristics of the TM3TI8T / TM3TI8TG expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

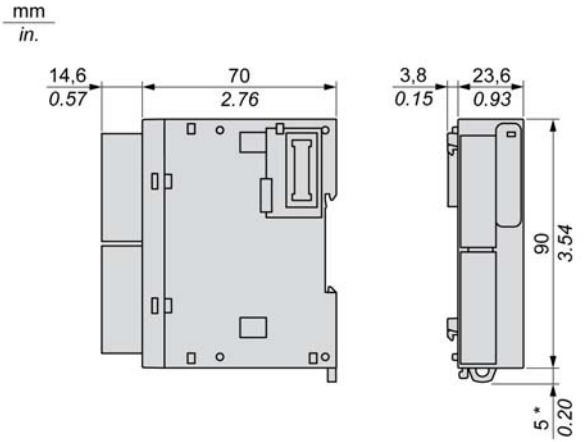
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3TI8T / TM3TI8TG expansion modules:



NOTE: * 8.5 mm (0.33 in) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	40 mA (no load) 45 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	30 mA (no load) 30 mA (full load)

Input Characteristics

The following table describes the input characteristics of the TM3TI8T / TM3TI8TG expansion modules:

Characteristics	Value			
	Thermocouple type		Thermistor	
Input range	K	–200...1300 °C (–328...2372 °F)	NTC	Measured resistor range: 100...10 kΩ) Calculated temperature range (with R0, T0, B): –90...150 °C (–130...302 °F)
	J	–200...1000 °C (–328...1832 °F)		
	R	0...1760 °C (32...3200 °F)		
	S	0...1760 °C (32...3200 °F)		
	B	0...1820 °C (32...3308 °F)		
	E	–200...800 °C (–328...1472 °F)	PTC	100Ω..10 kΩ
	T	–200...400 °C (–328...752 °F)		
	N	–200...1300 °C (–328...1472 °F)		
	C	0...2315 °C (32...4199 °F)		
Input impedance	1 MΩ min		1 MΩ min	
Sample duration time	100 ms per enabled channel			
Input type	Single-ended input			
Operating mode	Self-scan			

Characteristics		Value			
		Thermocouple type		Thermistor	
Conversion mode		Sigma delta ADC			
Max accuracy at ambient 25 °C (77 °F)		±0.2 % of full scale Except:		See thermistor resistance error	
		R S	±6 °C at 0...200 °C		
		B	Non-guaranted at 0...300 °C		
		K J E T N	±0.4 % of full scale under 0 °C		
Temperature drift		±0.01 % of full scale			
Repeatability after stabilization time		±0.5 % of full scale			
Nonlinearity		±0.2 % of full scale			
Maximum input deviation		±1.0 % of full scale			
Resolution		K J R S B E T N C	15000 points 12000 points 17600 points 17600 points 18200 points 10000 points 6000 points 15000 points 23150 points	NTC	9900 points (100...10000 Ω) 2400 points (–90...150 °C)
				PTC	9900 points (100...10000 Ω)
Input value of LSB		0.1 °C (0.18 °F)		NTC	1 Ω or 0.1 °C (0.18 °F)
				PTC	1 Ω
Thermistor parameters (configuration per channel)		–		R0: -32768…32767 (1 Ω/LSB) T0: -32768…32767 (1/LSB) B: -32768…32767 (1 °C/LSB)	
Data type in application program		Scalable from –32768 to 32767			
Input data out of range detection		Yes			
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring			
	Recommended cable	Twisted-pair shielded cable			
	Crosstalk	1 LSB max			

Characteristics		Value	
		Thermocouple type	**Thermistor**
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Maximum continuous allowed overload (no damage)		N/A	N/A
Input filter		Software filter: 0...10 s (per 0.01 s unit)	
Behavior when external power is off		Input value is highest limit value The External power supply error status bit in the controller is ON.	

TM3TI8T / TM3TI8TG Wiring Diagram

Introduction

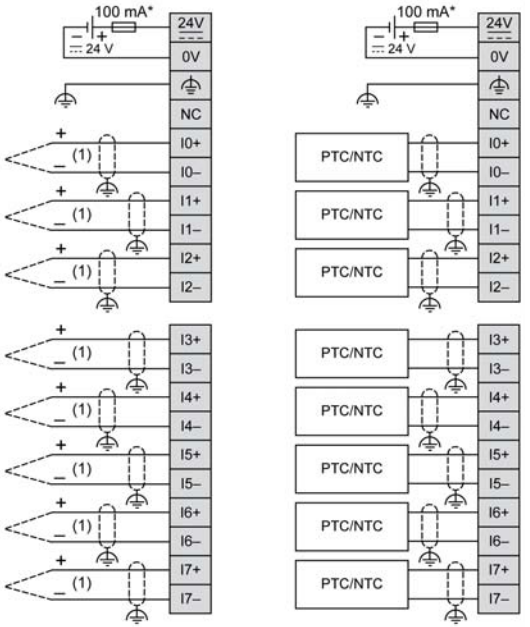
These expansion modules have a built-in removable spring or screw terminal block for the connection of inputs and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connection between the inputs, the sensors, and their commons:



***** Type T fuse

(1) Thermocouple

⚠ 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.

Part III
TM3 Analog Output Modules

What Is in This Part?

This part contains the following chapters:

Chapter 8
TM3AQ2 / TM3AQ2G Module 2 Outputs 24 Vdc

Overview

This chapter describes the TM3AQ2 / TM3AQ2G expansion modules, its characteristics, and its connection to the different actuators.

What Is in This Chapter?

This chapter contains the following topics:

TM3AQ2 / TM3AQ2G Presentation

Overview

TM3AQ2 (screw) and TM3AQ2G (spring) analog expansion modules:

- 2 channels 12 bits (Voltage, current)
- Removable screw or spring terminal block

Main Characteristics

Characteristic		Value	
Number of output channels		2 outputs	
Rated power supply		24 Vdc	
Signal type		Voltage	Current
Output range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Resolution		12 bits, or 11 bits + sign	
Connection type	TM3AQ2	Removable screw terminal block	
	TM3AQ2G	Removable spring terminal block	
Cable type and length	Type	Twisted pair shielded	
	Length	Max. 30 m (98 ft)	
Weight	TM3AQ2	115 g (4.05 oz)	
	TM3AQ2G	100 g (3.52 oz)	

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3AQ2 / TM3AQ2G Characteristics

Introduction

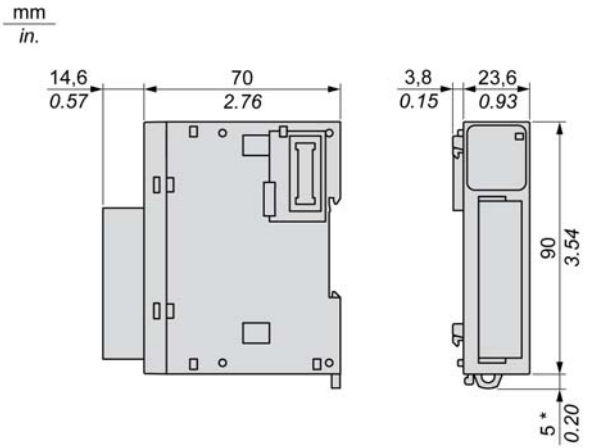
This section provides a description of the power limitation and the output characteristics of the TM3AQ2 / TM3AQ2G expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ 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 diagrams show the external dimensions for the TM3AQ2 / TM3AQ2G expansion modules:



NOTE: * 8.5 mm (0.33 in) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	30 mA (no load) 40 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	30 mA (no load) 70 mA (full load)

Output Characteristics

The table below describes the output characteristics of the TM3AQ2 / TM3AQ2G expansion modules:

Characteristics	Value	
	Voltage output	Current output
Software configurable signal type	Voltage output	Current output
Output range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Load impedance	1 kΩ min	300 Ω max
Application load type	Resistive load	
Settling time	1 ms	
Max accuracy at ambient 25 °C (77 °F)	±0.1 % of full scale	
Temperature drift	±0.006 % of full scale	
Repeatability after stabilization time	±0.4 % of full scale	
Nonlinearity	±0.01 % of full scale	
Output ripple	20 mV max	
Overshoot	0 %	
Maximum output deviation	±1.0 % of full scale	
Resolution	12 bits, or 11 bits + sign (4096 points)	
Input value of LSB	2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program	0...4095 (range 0...10 Vdc) –2048…+2047 (range –10…+10 Vdc)	0...4095
	Scalable from –32768 to 32767	

Characteristics		**Value**	
		Voltage output	**Current output**
Input data out of range detection		Yes	
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Behavior when external power is off		Input value is 0 The External power supply error status bit in the controller is ON.	

TM3AQ2 / TM3AQ2G Wiring Diagram

Introduction

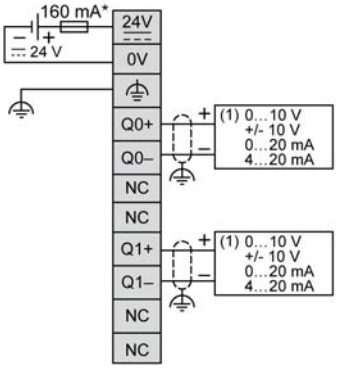
These expansion modules have a built-in removable screw or spring terminal block for the connection of outputs and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connection between the outputs, the actuators, and their commons:



***** Type T fuse

(1) Voltage/current pre-actuator

⚠ 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.

Chapter 9
TM3AQ4 / TM3AQ4G Module 4 Outputs 24 Vdc

Overview

This chapter describes the TM3AQ4 / TM3AQ4G expansion modules, its characteristics, and its connection to the different actuators.

What Is in This Chapter?

This chapter contains the following topics:

TM3AQ4 / TM3AQ4G Presentation

Overview

TM3AQ4 (screw) and TM3AQ4G (spring) analog expansion modules:

- 4 channels 12 bits (Voltage, current)
- Removable screw or spring terminal block

Main Characteristics

Characteristic		Value	
Number of output channels		4 outputs	
Rated power supply		24 Vdc	
Signal type		Voltage	Current
Output range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Resolution		12 bits, or 11 bits + sign	
Connection type	TM3AQ4	Removable screw terminal block	
	TM3AQ4G	Removable spring terminal block	
Cable type and length	Type	Twisted pair shielded	
	Length	Max. 30 m (98 ft)	
Weight	TM3AQ4	115 g (4.05 oz)	
	TM3AQ4G	100 g (3.52 oz)	

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3AQ4 / TM3AQ4G Characteristics

Introduction

This section provides a description of the output characteristics of the TM3AQ4 / TM3AQ4G expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

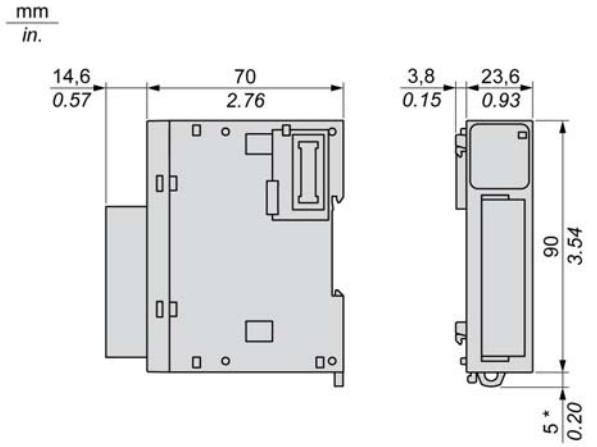
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3AQ4 / TM3AQ4G expansion modules:



NOTE: * 8.5 mm (0.33 in) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	40 mA (no load) 50 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	50 mA (no load) 125 mA (full load)

Output Characteristics

The table below describes the output characteristics of the TM3AQ4 / TM3AQ4G expansion modules:

Characteristics	Value	
	Voltage output	**Current output**
Software configurable signal type	Voltage output	Current output
Output range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Load impedance	1 kΩ min	300 Ω max
Application load type	Resistive load	
Settling time	1 ms	
Max accuracy at ambient 25 °C (77 °F)	±0.2 % of full scale	
Temperature drift	±0.01 % of full scale	
Repeatability after stabilization time	±0.4 % of full scale	
Nonlinearity	±0.2 % of full scale	
Output ripple	20 mV max	
Overshoot	0 %	
Maximum output deviation	±1.0 % of full scale	
Resolution	12 bits, or 11 bits + sign (4096 points)	
Input value of LSB	2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program	0...4095 (range 0...10 Vdc) –2048…+2047 (range –10…+10 Vdc)	0…4095
	Scalable from –32768 to 32767	
Input data out of range detection	Yes	

Characteristics		Value	
		Voltage output	**Current output**
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Behavior when external power is off		The External power supply error status bit in the controller is ON.	

TM3AQ4 / TM3AQ4G Wiring Diagram

Introduction

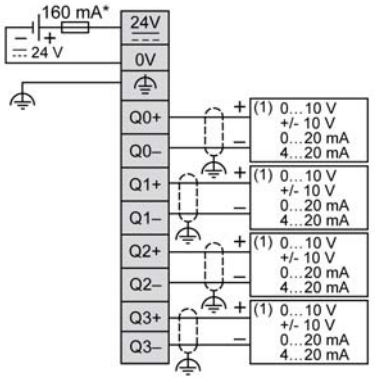
These expansion modules have a built-in removable screw or spring terminal block for the connection of outputs and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connection between the outputs, the actuators, and their commons:



***** Type T fuse

(1) Voltage/current pre-actuator

Part IV
TM3 Analog Mixed Input/Output Modules

What Is in This Part?

This part contains the following chapters:

Chapter 10
TM3AM6 / TM3AM6G Mixed I/O Module 4 Inputs/2 Outputs 24 Vdc

Overview

This chapter describes the TM3AM6 / TM3AM6G expansion modules, its characteristics, and its connection to the different sensors and actuators.

What Is in This Chapter?

This chapter contains the following topics:

TM3AM6 / TM3AM6G Presentation

Overview

TM3AM6 (screw) and TM3AM6G (spring) analog expansion modules:

- 4 input channels 12 bits (Voltage, current)
- 2 output channels 12 bits (Voltage, current)
- Removable screw or spring terminal block

Main Characteristics

Characteristic		**Value**			
Number of channels		4 inputs		2 outputs	
Rated power supply		24 Vdc			
Signal type		Voltage	Current	Voltage	Current
Input range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Resolution		12 bits, or 11 bits + sign			
Connection type	TM3AM6	Removable screw terminal block			
	TM3AM6G	Removable spring terminal block			
Cable type and length	Type	Twisted pair shielded			
	Length	Max. 30 m (98 ft)			
Weight	TM3AM6	110 g (3.88 oz)			
	TM3AM6G	100 g (3.52 oz)			

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3AM6 / TM3AM6G Characteristics

Introduction

This section provides a description of the electrical, the input/output characteristics of the TM3AM6 / TM3AM6G expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

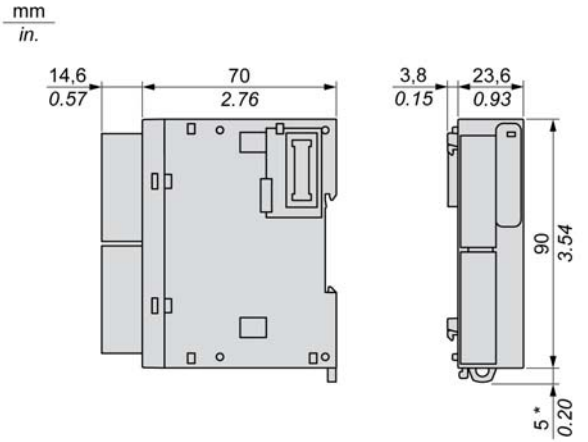
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3AM6 / TM3AM6G expansion modules:



NOTE: * 8.5 mm (0.33 in) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	45 mA (no load) 55 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	55 mA (no load) 100 mA (full load)

Input Characteristics

The table below describes the input characteristics of the TM3AM6 / TM3AM6G expansion modules:

Characteristics	Value	
	Voltage input	Current input
Input range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Input impedance	1 MΩ min	50 Ω max
Sample duration time	Software configurable: 1 ms or 10 ms per channel	
Input type	single-ended input	
Operating mode	Self-scan	
Conversion mode	Sigma delta ADC	
Max accuracy at ambient 25 °C (77 °F)	±0.2 % of full scale	
Temperature drift	±0.01 % of full scale	
Repeatability after stabilization time	±0.5 % of full scale	
Nonlinearity	±0.2 % of full scale	
Maximum input deviation	±1.0 % of full scale	
Resolution	12 bits (4096 points)	
Input value of LSB	2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program	Scalable from –32768 to 32767	
Input data out of range detection	Yes	

Characteristics		Value	
		Voltage input	**Current input**
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Maximum continuous allowed overload (no damage)		13 Vdc	40 mA
Input filter		Software filter: 0...10 s (per 0.01 s unit)	
Behavior when external power is off		Input value is 0 The External power supply error status bit in the controller is ON.	

Output Characteristics

The table below describes the output characteristics of the TM3AM6 / TM3AM6G expansion modules:

Characteristics	Value	
	Voltage output	**Current output**
Software configurable signal type	Voltage output	Current output
Output range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Load impedance	1 kΩ min	300 Ω max
Application load time	Resistive load	
Settling time	1 ms	
Max accuracy at ambient 25 °C (77 °F)	±0.2 % of full scale	
Temperature drift	±0.01 % of full scale	
Repeatability after stabilization time	±0.4 % of full scale	

Characteristics		**Value**	
		Voltage output	**Current output**
Nonlinearity		±0.2 % of full scale	
Output ripple		20 mV max	
Overshoot		0 %	
Maximum output deviation		±1.0 % of full scale	
Resolution		12 bits (4096 points)	
Input value of LSB		2.44 mV (range 0...10 Vdc) 4.88 mV (range –10...+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program		0...4095 (range 0...10 Vdc) –2048…+2047 (range –10…+10 Vdc)	0...4095
		Scalable from –32768 to 32767	
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Behavior when external power is off		The External power supply error status bit in the controller is ON.	

TM3AM6 / TM3AM6G Wiring Diagram

Introduction

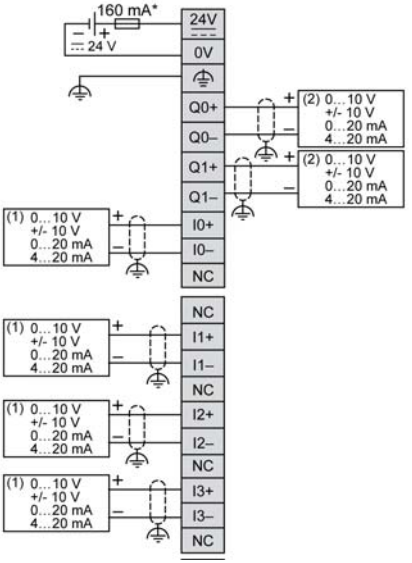
These expansion modules have a built-in removable screw or spring terminal block for the connection of inputs, outputs, and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connections between the inputs and outputs, the sensors and actuators, and their commons:



***** Type T fuse
(1) Current/Voltage analog output device
(2) Current/Voltage analog input device

⚠ 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.

Chapter 11
TM3TM3 / TM3TM3G Mixed I/O Module 2 Inputs/1 Output 24 Vdc

Overview

This chapter describes the TM3TM3 / TM3TM3G expansion modules, its characteristics, and its connection to the different sensors and actuators.

What Is in This Chapter?

This chapter contains the following topics:

TM3TM3 / TM3TM3G Presentation

Overview

TM3TM3 (screw) and TM3TM3G (spring) analog expansion modules:

- 2 input channels 16 bits (Voltage, current, thermocouple, 3-wire-RTD)
- 1 output channel 12 bits (Voltage, current)
- Removable screw or spring terminal block

Main Characteristics

Characteristic		**Value**					
Number of channels		2 inputs				1 output	
Rated power supply		24 Vdc					
Signal type		Voltage	Current	Thermocouple	3-wire-RTD	Voltage	Current
Input range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA	Type K, J, R, S, B, E, T, N, C	PT100, PT1000, NI100, NI1000	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Resolution max		16 bits, or 15 bits + sign				12 bits (4096 points)	
Connection type	TM3TM3	Removable screw terminal block					
	TM3TM3G	Removable spring terminal block					
Cable type and length	Type	Twisted pair shielded					
	Length	Max. 30 m (98 ft)					
Weight	TM3TM3	115 g (4.05 oz)					
	TM3TM3G	100 g (3.52 oz)					

Status LEDs

The following figure shows the status LEDs:

The following table describes the status LEDs:

LED	Color	Status	Description
PWR	Green	On	Indicates that TM3 bus power is applied.
		Off	Indicates that TM3 bus power is removed.

TM3TM3 / TM3TM3G Characteristics

Introduction

This section provides a description of the electrical, the input/output characteristics of the TM3TM3 / TM3TM3G expansion modules.

See also Environmental Characteristics *(see page 21)*.

⚠ WARNING

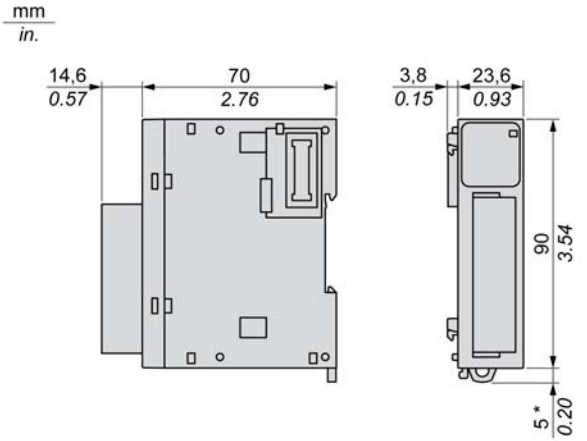
UNINTENDED EQUIPMENT OPERATION

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 diagrams show the external dimensions for the TM3TM3 / TM3TM3G expansion modules:



NOTE: * 8.5 mm (0.33 in) when the clamp is pulled out.

General Characteristics

Characteristics	Value
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
Connector insertion/removal durability	100 times minimum
Current draw on 5 Vdc internal bus	55 mA (no load) 60 mA (full load)
Current draw on 24 Vdc internal bus	0 mA
Current draw on external 24 Vdc	55 mA (no load) 80 mA (full load)

Input Characteristics

The table below describes the input characteristics of the TM3TM3 / TM3TM3G expansion modules:

Characteristics	Value					
	Voltage input	Current input	Thermocouple type		3-wire-RTD	
Input range	0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA	K	–200...1300 °C (–328...2372 °F)	PT100	–200...850 °C (–328...1562 °F)
			J	–200...1000 °C (–328...1832 °F)	PT1000	–200...600 °C (–328...1112 °F)
			R	0...1760 (32...3200 °F)	NI100	–60...180 °C (–76...356 °F)
			S	0...1760 °C (32...3200 °F)	NI1000	–60...180 °C) (–76...356 °F)
			B	0...1820 °C (32...3308 °F)		
			E	–200...800 (–328...1472 °F)		
			T	–200...400 °C (–328...752 °F)		
			N	–200...1300 (–328...1472 °F)		
			C	0...2315 °C (32...4199 °F)		
Input impedance	1 MΩ min	50 Ω max	1 MΩ min		1 MΩ min	
Sample duration time	Software configurable: 10 ms or 100 ms per enabled channel		100 ms per enabled channel			

Characteristics	Value					
	Voltage input	Current input	Thermocouple type		3-wire-RTD	
Input type	Single-ended input					
Operating mode	Self-scan					
Conversion mode	Sigma delta ADC					
Max accuracy at ambient 25 °C (77 °F)	±0.1 % of full scale		±0.1 % of full scale Except:		±0.1 % of full scale	
			R S	±6 °C at 0...200 °C		
			B	Non-guaranted at 0...300 °C		
			K J E T N	±0.4 % of full scale under 0 °C		
Temperature drift	±0.006 % of full scale					
Repeatability after stabilization time	±0.5 % of full scale					
Nonlinearity	±0.1 % of full scale					
Maximum input deviation	±1.0 % of full scale					
Resolution	16 bits, or 15 bits + sign (65536 points)		K J R S B E T N C	15000 points 12000 points 17600 points 17600 points 18200 points 10000 points 6000 points 15000 points 23150 points	PT100 PT1000 NI100 NI1000	10500 points 8000 points 2400 points 2400 points
Input value of LSB	0.15 mV (range 0...10 Vdc) 0.30 mV (range –10...+10 Vdc)	0.30 µA (range 0...20 mA) 0.244 µA (range 4...20 mA)	0.1 °C (0.18 °F)			
Data type in application program	Scalable from –32768 to 32767					
Input data out of range detection	Yes					

Characteristics		**Value**			
		Voltage input	**Current input**	**Thermocouple type**	**3-wire-RTD**
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring			
	Recommended cable	Twisted-pair shielded cable			
	Crosstalk	1 LSB max			
Isolation	Between external power supply and inputs	1500 Vac			
	Between inputs and internal logic circuits	500 Vac			
Maximum continuous allowed overload (no damage)		13 Vdc	40 mA	N/A	
Input filter		Software filter: 0...10 s (per 0.01 s unit)			
Behavior when temperature sensor is broken		N/A		Input value is highest limit value Highest limit flag is ON	
Behavior when external power is off		Input value is 0		Input value is highest limit value	
		The External power supply error status bit in the controller is ON.			

Output Characteristics

The table below describes the output characteristics of the TM3TM3 / TM3TM3G expansion modules:

Characteristics		Value	
		Voltage output	**Current output**
Software configurable signal type		Voltage output	Current output
Output range		0...10 Vdc –10...+10 Vdc	0...20 mA 4...20 mA
Load impedance		1 kΩ min	300 Ω max
Application load time		Resistive load	
Settling time		1 ms	
Max accuracy at ambient 25 °C (77 °F)		±0.1 % of full scale	
Temperature drift		±0.006 % of full scale	
Repeatability after stabilization time		±0.4 % of full scale	
Nonlinearity		±0.01 % of full scale	
Output ripple		20 mV max	
Overshoot		0 %	
Maximum output deviation		±1.0 % of full scale	
Resolution		12 bits (4096 points)	
Input value of LSB		2.44 mV (range 0...10 Vdc) 4.88 mV (range –10…+10 Vdc)	4.88 µA (range 0...20 mA) 3.91 µA (range 4...20 mA)
Data type in application program		0...4095 (range 0…10 Vdc) –2048…+2047 (range –10…+10 Vdc)	0...4095
		Scalable from –32768 to 32767	
Noise resistance	Maximum temporary deviation during perturbations	±4 % maximum when EMC perturbation is applied to the power and I/O wiring	
	Recommended cable	Twisted-pair shielded cable	
	Crosstalk	1 LSB max	
Isolation	Between external power supply and inputs	1500 Vac	
	Between inputs and internal logic circuits	500 Vac	
Behavior when external power is off		The External power supply error status bit in the controller is ON.	

TM3TM3 / TM3TM3G Wiring Diagram

Introduction

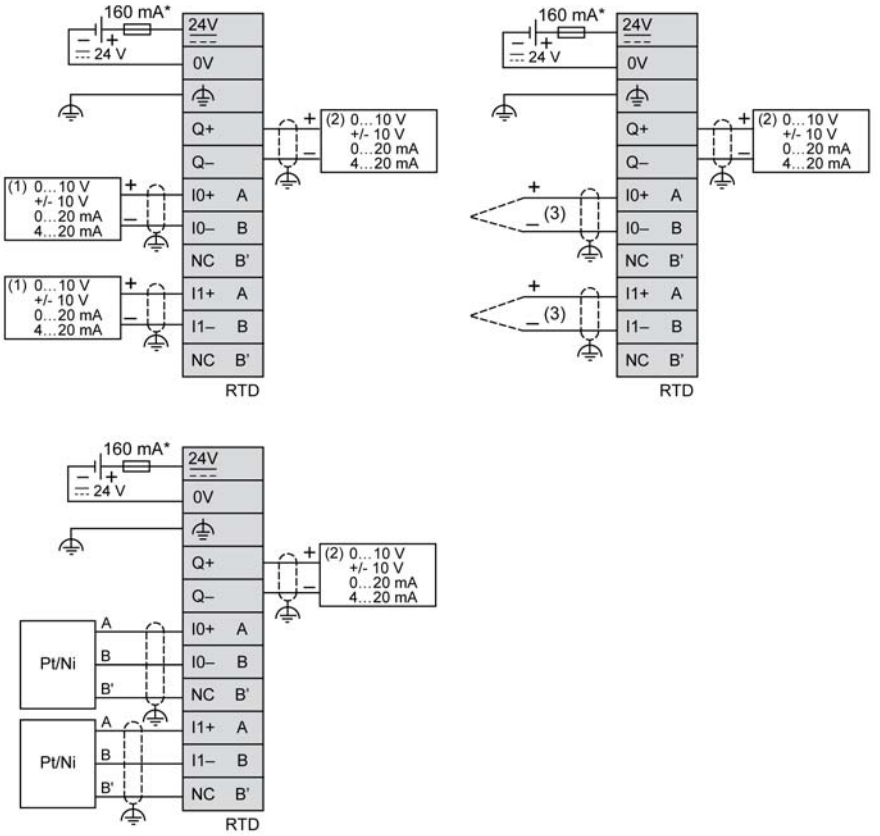
These expansion modules have a built-in removable screw or spring terminal block for the connection of inputs, outputs, and power supply.

Wiring Rules

See Wiring Best Practices *(see page 37)*.

Wiring Diagram

The following figure illustrates the connections between the inputs and outputs, the sensors and actuators, and their commons:



***** Type T fuse

(1) Current/Voltage analog output device

(2) Current/Voltage analog input device
(3) Thermocouple

⚠ 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.

Glossary

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

expansion connector

A connector to attach expansion I/O modules.

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.

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.

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.

R

RJ-45

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

T

terminal block

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

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W