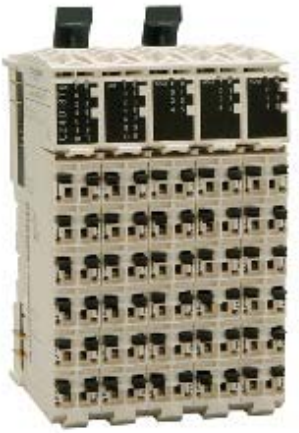
Modicon TM5
Compact I/O Modules
Hardware Guide

09/2020



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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.

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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, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

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

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

PLEASE NOTE

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

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

About the Book

At a Glance

Document Scope

This manual describes the hardware implementation of the ModiconTM5 Compact I/O modules. It provides parts descriptions, specifications, wiring diagrams, installation and setup for Modicon TM5 Compact I/O modules.

Validity Note

This document has been updated for the release of EcoStruxure™ Machine Expert V1.2.5.

The technical characteristics of the devices described in the present document also appear online. To access the 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 reference or 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 datasheet.
6	To save or print a datasheet as a .pdf file, click **Download XXX product datasheet**.

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

Related Documents

Title of Documentation	Reference Number
Modicon TM5 Expansion Modules Configuration Programming Guide	*EIO0000003179 (ENG)* *EIO0000003180 (FRE)* *EIO0000003181 (GER)* *EIO0000003182 (SPA)* *EIO0000003183 (ITA)* *EIO0000003184 (CHS)*
Modicon TM5 / TM7 Flexible System - System Planning and Installation Guide	*EIO0000003161 (ENG)* *EIO0000003162 (FRE)* *EIO0000003163 (GER)* *EIO0000003164 (SPA)* *EIO0000003165 (ITA)* *EIO0000003166 (CHS)*
TM5 Compact I/O Modules Instruction Sheet	*BBV56043 (ENG)*

You can download these technical publications and other technical information from our website at https://www.se.com/ww/en/download/ .

Product Related Information

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

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

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

⚠ DANGER

POTENTIAL FOR EXPLOSION

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

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

⚠ WARNING

LOSS OF CONTROL

- 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
TM5 Compact I/O Modules General Overview

What Is in This Part?

This part contains the following chapters:

Chapter 1
TM5 System General Rules for Implementing

What Is in This Chapter?

This chapter contains the following topics:

Installation and Maintenance Requirements

Before Starting

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

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

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

NOTICE

ELECTROSTATIC DISCHARGE

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

Failure to follow these instructions can result in equipment damage.

Disconnecting Power

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

⚠⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

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

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

Programming Considerations

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

Operating Environment

⚠ DANGER

POTENTIAL FOR EXPLOSION

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

Installation Considerations

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

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

Wiring Best Practices

Introduction

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

Wiring Rules

⚠⚠ 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.

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

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

Refer to the section Grounding the TM5 System to ground the shielded cables.

This table provides the wire sizes to use with the removable spring terminal blocks (TM5ACTB06, TM5ACTB12, TM5ACTB12, TM5ACTB12PS, TM5ACTB32):

mm / in. 9 / 0.35				
mm²	0,08…2,5	0,25…2,5	0,25…1,5	2 x 0,25...2 x 0,75
AWG	28…14	24…14	24…16	2 x 24…2 x 18

This table provides the wire sizes to use with the TM5ACTB16 terminal blocks:

mm / in. 9 / 0.35			
mm²	0,08…1,5	0,25…1,5	0,25…0,75
AWG	28…16	24...16	24...20

⚠ DANGER

FIRE HAZARD

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

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

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

DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

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

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

TM5 Terminal Block

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

DANGER

ELECTRIC SHOCK OR UNINTENDED EQUIPMENT OPERATION

Connect the terminal blocks to their designated location.

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

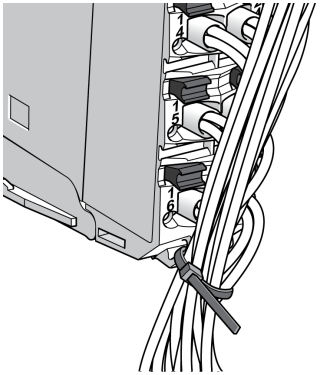
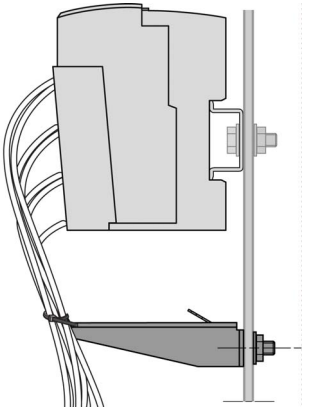
NOTE: To help prevent a terminal block from being inserted incorrectly, ensure that each terminal block and electronic module is clearly and uniquely coded.

TM5 Strain Relief Using Cable Tie

There are 2 methods to reduce the stress on cables:

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

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

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

⚠ WARNING

ACCIDENTAL DISCONNECTION FROM PROTECTIVE GROUND (PE)

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

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

Protecting Outputs from Inductive Load Damage

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

⚠ WARNING

INDUCTIVE LOADS

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

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

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

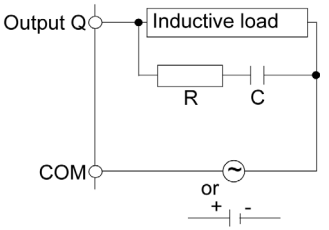
⚠ WARNING

RELAY OUTPUTS WELDED CLOSED

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

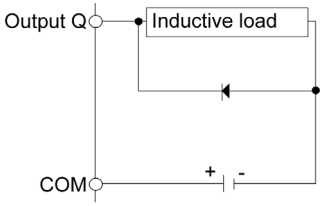
Failure to follow these instructions can result in death, serious injury, or equipment damage.

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



C Value from 0.1 to 1 µF
R Resistor of approximately the same resistance value as the load

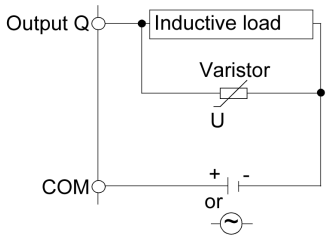
Protective circuit B: this protection circuit can be used for DC load power circuits.



Use a diode with the following ratings:

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

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



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

TM5 Environmental Characteristics

Enclosure Requirements

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

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

Environmental Characteristics

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

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

The table below provides the general environmental characteristics:

Characteristic		Minimum Specification	Tested Range	
Standard		IEC61131-2	–	
Agency Standards		UL 508 CSA 22.2 No. 142-M1987 CSA 22.2 No. 213-M1987	–	
Ambient operating temperature		–	Horizontal installation	0...55 °C (32...131 °F)
		–	Vertical installation	0...50 °C (32...122 °F)
Storage temperature		–	-25...70 °C (-13...158 °F)	
Relative humidity		–	5...95% (non-condensing)	
Degree of pollution		IEC60664	2	
Degree of protection		IEC61131-2	IP20	
Corrosion immunity		None	–	
Operating altitude		–	0...2000 m (0...6.560 ft.)	
Storage altitude		–	0...3000 m (0...9.842 ft.)	
Vibration resistance		–	Mounted on a DIN rail	3.5 mm (0.138 in.) fixed amplitude from 5...8.4 Hz 9.8 m/s^2 (1 g_n) fixed acceleration from 8.4...150 Hz
Mechanical shock resistance		–	147 m/s^2 (15 g_n) for a duration of 11 ms	
Connection type	Removable spring terminal block	–	–	
Connector insertion/removal cycles		–	50	

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

Electromagnetic Susceptibility

The following table provides the TM5 System electromagnetic susceptibility specifications:

Characteristic	Minimum Specification	Tested Range
Electrostatic discharge	IEC/EN 61000-4-2	8 kV (air discharge), criteria B 4 kV (contact discharge), criteria B
Electromagnetic fields	IEC/EN 61000-4-3	10 V/m (80 MHz...2 GHz), criteria A 10 V/m (80 MHz...2.7 GHz)(1)
Fast transients burst	IEC/EN 61000-4-4	Power lines: 2 kV, criteria B I/O: 1 kV, criteria B Shielded cable: 1 kV, criteria B Repetition rate: 5 and 100 KHz
Surge immunity 24 Vdc circuit	IEC/EN 61000-4-5	1 kV in common mode, criteria B 0.5 kV in differential mode, criteria B
Surge immunity 230 Vac circuit	IEC/EN 61000-4-5	2 kV in common mode, criteria B 1 kV in differential mode, criteria B
Induced electromagnetic field	IEC/EN 61000-4-6	10 V_{eff} (0.15...80 MHz), criteria A
Conducted emission	EN 55011 (IEC/CISPR11)	150...500 kHz, quasi peak 79 dB (µV) 500 kHz...30 MHz, quasi peak 73 dB (µV)
Radiated emission	EN 55011 (IEC/CISPR11)	30...230 MHz, 10 m@40 dB (µV/m) 230 MHz...1 GHz, 10 m@47 dB (µV/m)

Criteria A Uninterrupted operation during test.
Criteria B Brief interruption during the test allowed.
(1) Applies for TM5SE1IC20005 and TM5SE1MISC20005.

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

Installation Guidelines

Installation

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

Spacing requirement	For mounting positions and minimum clearances, the electronic modules are mounted according to the rules defined for the controllers. Refer to the *Enclosing the TM5 System*.
Electronic modules installation	Refer to: ● *TM5 Association Table*. ● *Expanding the TM5 System*.
Accessories installation	Refer to the *Installation of Accessories*.

Chapter 2
General Overview

What Is in This Chapter?

This chapter contains the following topics:

General Description

Overview

The TM5 Compact I/O modules are I/O expansion modules for your TM5 system. The compact I/O modules are a group of five, regular TM5 electronic I/O modules under a single reference. The individual electronic modules are identified by a four-character reference on their front face, while the reference of the entire group can be found on the side of the compact I/O module. Every regular TM5 electronic I/O module channel has a status LED.

The terminals blocks are assembled on the compact I/O module when delivered.

The compact I/O module uses a single address on the TM5 Bus.

The five electronic modules included in the compact I/O module are not individually replaceable.

NOTE: Unlike the TM5 digital and analog I/O electronic modules, the compact I/O modules described in this manual do not have hot-swap capability. Do not attempt to hot swap these modules.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not attempt to hot swap TM5 Compact I/O modules.

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

The range of compact I/O modules includes:
- digital input electronic modules
- digital output electronic modules
- analog input electronic modules
- analog output electronic modules

Compact I/O Modules Description

The following table shows the compact digital I/O modules features with corresponding number and channel type:

Reference	Number and Channel Type			
	Digital Inputs		Digital Outputs	
TM5C24D18T *(see page 39)*	2x12	24	3x6	18
TM5C12D8T *(see page 41)*	3x4	12	2x4	8
TM5C24D12R *(see page 43)*	2x12	24	2x6Rel	12 Relays

The following table shows the compact analog I/O modules features with corresponding number and channel type:

Reference	Number and Channel Type			
	Analog Inputs		Analog Outputs	
TM5CAI8O8VL *(see page 46)*	2x4AI ±10 V	8	2x4AO ±10 V	8
TM5CAI8O8CL *(see page 48)*	2x4AI 0-20 mA / 4-20 mA	8	2x4AO 0-20 mA	8
TM5CAI8O8CVL *(see page 50)*	1x4AI ±10 V	4	1x4AO ±10 V	4
	1x4AI 0-20 mA / 4-20 mA	4	1x4AO 0-20 mA	4

The following table shows the compact mixed I/O modules features with corresponding number and channel type:

Reference	Number and Channel Type							
	Digital Inputs		Digital Outputs		Analog Inputs		Analog Outputs	
TM5C12D6T6L *(see page 52)*	2x6	12	1x6	6	1x4	4	1x2	2

Digital Input and Output Electronic Modules Features

Digital inputs convert the electronic input signal into a binary value in the controller.

Digital outputs convert the binary value in the controller into an electronic output signal.

The following table shows the digital input and output electronic modules features, with corresponding channel type and voltage/current

Reference	Number of Channels	Voltage/Current	Wiring	Signal Type
Digital Input Electronic Modules				
4In *(see page 57)*	4	24 Vdc / 3.75 mA	3 wires	sink
6In *(see page 61)*	6	24 Vdc / 3.75 mA	2 wires	sink
12In *(see page 64)*	12	24 Vdc / 3.75 mA	1 wire	sink
Digital Output Electronic Modules				
4Out *(see page 67)*	4	24 Vdc / 0.5 A	3 wires	source
6Out *(see page 72)*	6	24 Vdc / 0.5 A	2 wires	source
Digital Output Relay Electronic Modules				
6Rel *(see page 77)*	6	30 Vdc / 2 A 240 Vac / 2 A	6 normally open contacts relays	sink/source

Analog Input and Output Electronic Modules Features

Analog inputs convert measured values (voltages, currents) into numerical values which can be processed by the controller.

Analog outputs convert controller internal numerical values into voltages or currents.

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

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

The following table shows the analog input and output electronic modules features:

Reference	Number of Channels	Digital Converter Resolution	Voltage/Current
Analog Input Electronic Module			
4AI ±10 V *(see page 83)*	4	12 bit	-10...10 Vdc
4AI 0-20 mA / 4-20 mA *(see page 87)*	4	12 bit	0...20 mA / 4...20 mA
4AI ±10 V / 0-20 mA / 4-20 mA *(see page 91)*	4	12 bit + sign 12 bit	-10...+10 Vdc 0...20 mA/4...20 mA
Analog Output Electronic Module			
4AO ±10 V *(see page 95)*	4	12 bit	-10...10 Vdc
4AO 0-20 mA *(see page 99)*	4	12 bit	0...20 mA
2AO ±10 V / 0-20 mA *(see page 103)*	2	12 bit + sign 12 bit	-10...+10 Vdc 0...20 mA

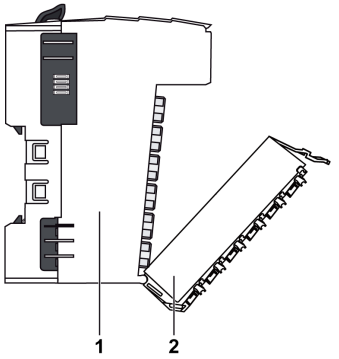
Physical Description

Overview

The compact I/O module is composed of:

- bus base and a set of five electronic modules
- a set of five terminal blocks

The following figure shows the elements of a compact I/O module.



1. Integrated bus base and electronic modules of the compact I/O module (inseparable)
2. Terminal blocks

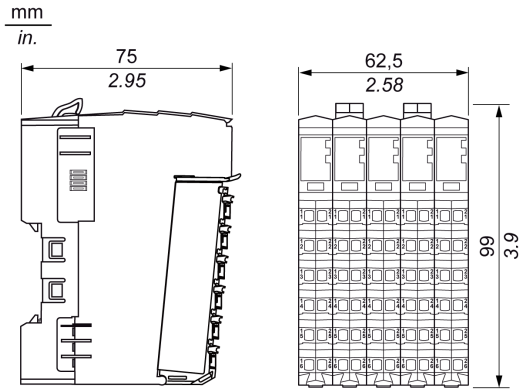
See also the physical description of the electronic module and terminal block.

NOTE: The terminal blocks associated to the compact I/O block are a 12-pin white terminal block.

NOTICE
ELECTROSTATIC DISCHARGE ● Never touch the contacts of the electronic module. ● Always keep the connector in place during normal operation. **Failure to follow these instructions can result in equipment damage.**

Dimensions

The following figure shows the dimensions of a compact I/O module:

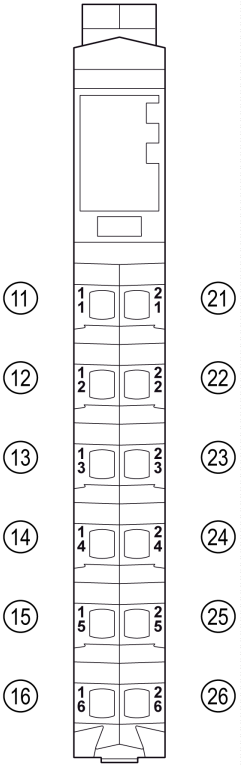


Installation

The installation procedure of the modules is to install and assemble them directly on the DIN rail.

Pin Assignment

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



See also the physical description of the terminal block.

Accessories

Refer to the Installation of Accessories.

Labeling

Refer to the Labeling the TM5 System.

Part II
TM5 Compact I/O Modules

What Is in This Part?

This part contains the following chapters:

Chapter 3
General Description

Introduction

This chapter describes the compact I/O modules.

What Is in This Chapter?

This chapter contains the following sections:

Section 3.1
Compact Digital I/O Modules

Introduction

This section describes the compact digital I/O modules.

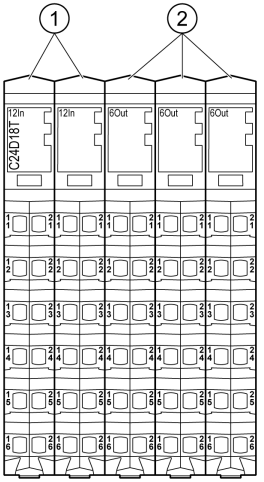
What Is in This Section?

This section contains the following topics:

TM5C24D18T General Description

Presentation

The following figure shows the electronic modules of the TM5C24D18T:



N°	Designation	Refer to
1	Input electronic module / 12 digital inputs	12In *(see page 64)*
2	Output electronic module / 6 digital outputs	6Out *(see page 72)*

General Characteristics

⚠ 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 provides the general characteristics of the TM5C24D18T module:

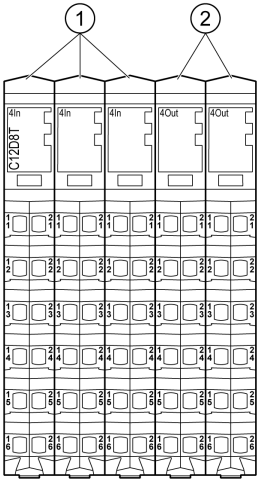
General characteristics	
Rated power supply voltage Power supply source	24 Vdc Connected to the 24 Vdc I/O power segment
Power supply range	20.4...28.8 Vdc
24 Vdc I/O power segment current draw	140 mA
Max. current consumed by the loads on the 24 Vdc I/O power segment	9000 mA
Max. current for sensors supply	–
Max. current for actuators supply	–
TM5 Bus 5 Vdc current draw	70 mA
Power dissipation	3.71 W max.
Weight	240 g (8.46 oz)
Id code for firmware update	45268 dec

See also Environmental Characteristics *(see page 23)*.

TM5C12D8T General Description

Presentation

The following figure shows the electronic modules of the TM5C12D8T:



N°	Designation	Refer to
1	Input electronic module / 4 digital inputs	4In *(see page 57)*
2	Output electronic module / 4 digital outputs	4Out *(see page 67)*

General Characteristics

⚠ 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.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Use the sensor and actuator power supply only for supplying power to sensors or actuators connected to the module.

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

The following table provides the general characteristics of the TM5C12D8T module:

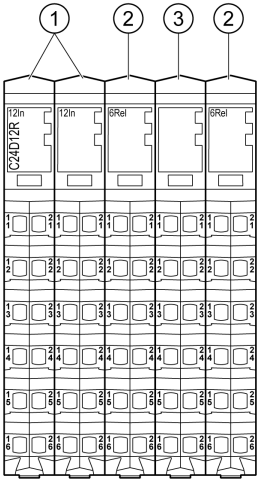
General characteristics	
Rated power supply voltage Power supply source	24 Vdc Connected to the 24 Vdc I/O power segment
Power supply range	20.4...28.8 Vdc
24 Vdc I/O power segment current draw	80 mA
Max. current consumed by the loads on the 24 Vdc I/O power segment	4000 mA
Max. current for sensors supply	1500 mA
Max. current for actuators supply	1000 mA
TM5 Bus 5 Vdc current draw	68 mA
Power dissipation	2.36 W max.
Weight	240 g (8.46 oz)
Id code for firmware update	45269 dec

See also Environmental Characteristics *(see page 23)*.

TM5C24D12R General Description

Presentation

The following figure shows the electronic modules of the TM5C24D12R:



N°	Designation	Refer to
1	Input electronic module / 12 digital inputs	12In *(see page 64)*
2	Relay output electronic module / 6 relay outputs	6Rel *(see page 77)*
3	Dummy module	Dummy Module *(see page 107)*

General Characteristics

⚠ 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 provides the general characteristics of the TM5C24D12R module:

General characteristics		
Input electronic module	Rated power supply voltage Power supply source	24 Vdc Connected to the 24 Vdc I/O power segment
	Power supply range	20.4...28.8 Vdc
Relay output electronic module	Rated power supply voltage Power supply source	30 Vdc / 230 Vac Connected to an external AC and DC power
	Power supply range	24...36 Vdc 184 Vac...276 Vac
General electronic module	24 Vdc I/O power segment current draw	165 mA
	Max. current consumed by the loads on the 24 Vdc I/O power segment (external power supply)	–
	Max. current for sensors supply	–
	Max. current for actuators supply	–
	TM5 Bus 5 Vdc current draw	68 mA
	Power dissipation	4.3 W max.
	Weight	260 g (9.17 oz)
	Id code for firmware update	45271 dec

Section 3.2
Compact Analog I/O Modules

Introduction

This section describes the compact analog I/O modules.

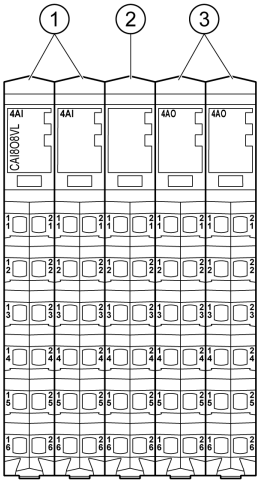
What Is in This Section?

This section contains the following topics:

TM5CAI8O8VL General Description

Presentation

The following figure shows the electronic modules of the TM5CAI8O8VL:



N°	Designation	Refer to
1	Analog Input electronic module / 4 Analog Inputs	4AI ±10 V *(see page 83)*
2	Dummy Module	Dummy Module *(see page 107)*
3	Analog Output electronic module / 4 Analog Outputs	4AO ±10 V *(see page 95)*

General Characteristics

⚠ 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 provides the general characteristics of the TM5CAI8O8VL module:

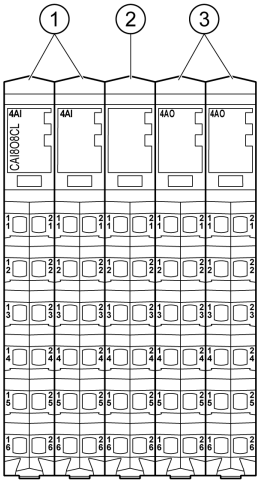
General characteristics	
Rated power supply voltage Power supply source	24 Vdc Connected to the 24 Vdc I/O power segment
Power supply range	20.4...28.8 Vdc
24 Vdc I/O power segment current draw	205 mA
TM5 Bus 5 Vdc current draw	52 mA
Power dissipation	5.25 W
Weight	252 g (8.89 oz)
Id code for firmware update	50611

See also Environmental Characteristics *(see page 23)*.

TM5CAI8O8CL General Description

Presentation

The following figure shows the electronic modules of the TM5CAI8O8CL:



N°	Designation	Refer to
1	Analog Input electronic module / 4 Analog Inputs	4AI 0-20 mA / 4-20 mA *(see page 87)*
2	Dummy Module	Dummy Module *(see page 107)*
3	Analog Output electronic module / 4 Analog Outputs	4AO 0-20 mA *(see page 99)*

General Characteristics

⚠ 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 provides the general characteristics of the TM5CAI8O8CL module:

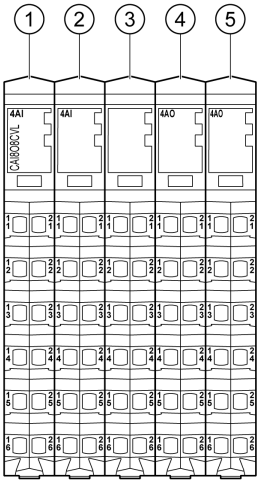
General characteristics	
Rated power supply voltage Power supply source	24 Vdc Connected to the 24 Vdc I/O power segment
Power supply range	20.4...28.8 Vdc
24 Vdc I/O power segment current draw	218 mA
TM5 Bus 5 Vdc current draw	50 mA
Power dissipation	5.25 W
Weight	248 g (8.75 oz)
Id code for firmware update	50612

See also Environmental Characteristics *(see page 23)*.

TM5CAI8O8CVL General Description

Presentation

The following figure shows the electronic modules of the TM5CAI8O8CVL:



N°	Designation	Refer to
1	Analog Input electronic module / 4 Analog Inputs	4AI ±10 V *(see page 83)*
2	Analog Input electronic module / 4 Analog Inputs	4AI 0-20 mA / 4-20 mA *(see page 87)*
3	Dummy Module	Dummy Module *(see page 107)*
4	Analog Output electronic module / 4 Analog Outputs	4AO ±10 V *(see page 95)*
5	Analog Output electronic module / 4 Analog Outputs	4AO 0-20 mA *(see page 99)*

General Characteristics

⚠ 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 provides the general characteristics of the TM5CAI8O8CVL module:

General characteristics	
Rated power supply voltage Power supply source	24 Vdc Connected to the 24 Vdc I/O power segment
Power supply range	20.4...28.8 Vdc
24 Vdc I/O power segment current draw	214 mA
TM5 Bus 5 Vdc current draw	50 mA
Power dissipation	5.25 W
Weight	250 g (8.82 oz)
Id code for firmware update	50663

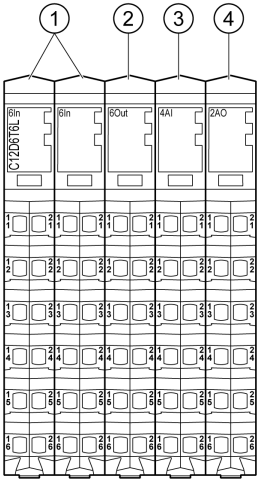
See also Environmental Characteristics *(see page 23)*.

Section 3.3
Compact Mixed I/O Modules

TM5C12D6T6L General Description

Presentation

The following figure shows the electronic modules of the TM5C12D6T6L:



N°	Designation	Refer to
1	Input electronic module / 6 digital inputs	6In *(see page 61)*
2	Output electronic module / 6 digital outputs	6Out *(see page 72)*
3	Analog Input electronic module / 4 analog inputs	4AI ±10 V / 0-20 mA *(see page 91)*
4	Analog Output electronic module / 2 analog outputs	2AO ±10 V / 0-20 mA *(see page 103)*

General Characteristics

⚠ 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 provides the general characteristics of the TM5C12D6T6L module:

General characteristics	
Rated power supply voltage Power supply source	24 Vdc Connected to the 24 Vdc I/O power segment
Power supply range	20.4...28.8 Vdc
24 Vdc I/O power segment current draw	290 mA
Max. current consumed by the loads on the 24 Vdc I/O power segment	3000 mA
Max. current for sensors supply	–
Max. current for actuators supply	–
TM5 Bus 5 Vdc current draw	69 mA
Power dissipation	7.3 W max.
Weight	250 g (8.81 oz)
Id code for firmware update	45270 dec

See also Environmental Characteristics *(see page 23)*.

Chapter 4
Compact I/O Electronic Modules

Introduction

This chapter describes the various electronic modules contained within the TM5 Compact I/O modules.

What Is in This Chapter?

This chapter contains the following sections:

Section 4.1
Digital I/O Electronic Modules

Introduction

This section describes the digital I/O electronic modules contained within the Compact I/O modules.

What Is in This Section?

This section contains the following topics:

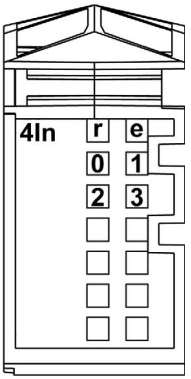
Digital Input 4In

Overview

The digital 4In electronic module is equipped with 4 sink inputs.

Status LEDs

The following figure shows the LEDs for 4In:



The following table shows the 4In status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
e+r	Steady red / single green flash		Invalid firmware
0-3	Green	Off	Corresponding input deactivated
		On	Corresponding input activated

Input Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the input characteristics of the 4In electronic module:

Input Characteristics		
Number of input channels		4
Wiring type		1 or 2 or 3 wires
Input type		Type 1
Signal type		Sink
Rated input voltage		24 Vdc
Input voltage range		20.4...28.8 Vdc
Rated input current at 24 Vdc		3.75 mA
Input impedance		6.4 kΩ
OFF state		5 Vdc max.
ON state		15 Vdc min.
Input filter	Hardware	≤100 µs
	Software	Default 1 ms, can be configured between 0 and 25 ms in 0.2 ms intervals.

Input Characteristics		
Isolation	Between input and internal bus	See note [1]
	Between channels	Not isolated

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

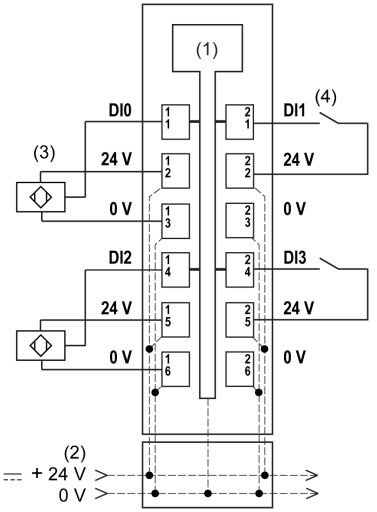
Sensor Supply

The table describes the sensor supply of the 4In electronic module:

Sensor supply	
Voltage	Power segment supply less voltage drop for internal protection.
Voltage drop for internal protection at 500 mA	2 Vdc max
Sensor supply current (for all powered connected sensors)	500 mA
Internal protection	Overload short circuit

Wiring Diagram

The following figure shows the wiring diagram of the 4In:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
3 3-wire sensor
4 2-wire sensor

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.

WARNING

UNINTENDED EQUIPMENT OPERATION

Use the sensor and actuator power supply only for supplying power to sensors or actuators connected to the module.

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

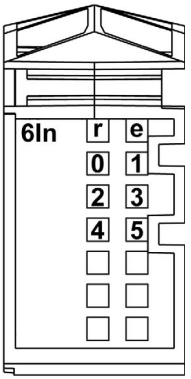
Digital Input 6In

Overview

The digital 6In electronic module is equipped with 6 sink inputs.

Status LEDs

The following figure shows the LEDs for 6In:



The following table shows the 6In status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
e+r	Steady red / single green flash		Invalid firmware
0-5	Green	Off	Corresponding input deactivated
		On	Corresponding input activated

Input Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the input characteristics of the 6In electronic module:

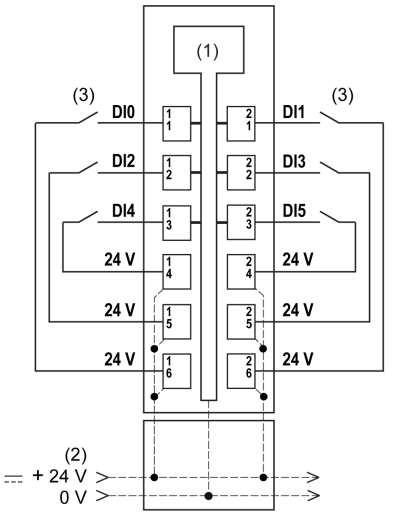
Input Characteristics		
Number of input channels		6
Wiring type		1 or 2 wires
Input type		Type 1
Signal type		Sink
Rated input voltage		24 Vdc
Input voltage range		20.4...28.8 Vdc
Rated input current at 24 Vdc		3.75 mA
Input impedance		6.4 kΩ
OFF state		5 Vdc max.
ON state		15 Vdc min.
Input filter	Hardware	≤100 µs
	Software	Default 1 ms, can be configured between 0 and 25 ms in 0.2 ms intervals.

Input Characteristics		
Isolation	Between input and internal bus	See note [1]
	Between channels	Not isolated

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

Wiring Diagram

The following figure shows the wiring diagram of the 6In:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
3 2-wire sensor

⚠ 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.

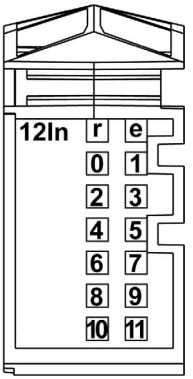
Digital Input 12In

Overview

The digital 12In electronic module is equipped with 12 sink inputs.

Status LEDs

The following figure shows the LEDs for 12In:



The following table shows the 12In status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
e+r	Steady red / single green flash		Invalid firmware
0-11	Green	Off	Corresponding input deactivated
		On	Corresponding input activated

Input Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

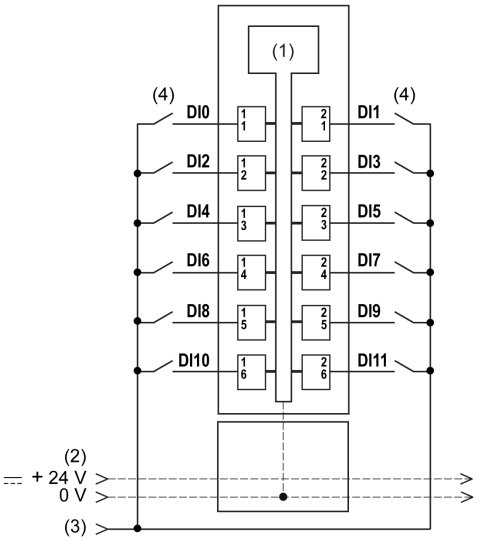
The following table provides the characteristics of the 12In electronic module:

Characteristic		Value
Number of input channels		12
Wiring type		1 wire
Input type		Type 1
Signal type		Sink
Rated input voltage		24 Vdc
Input voltage range		20.4...28.8 Vdc
De-rating	55...60 °C (131...140 °F)	11 channels activated at the same time
Rated input current at 24 Vdc		3.75 mA
Input impedance		6.4 kΩ
OFF state		5 Vdc max.
ON state		15 Vdc min.
Input filter	Hardware	≤100 µs
	Software	Default 1 ms, can be configured between 0 and 25 ms in 0.2 ms intervals.
Isolation	Between input and internal bus	See note [1]
	Between channels	Not isolated

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

Wiring Diagram

The following figure shows the wiring diagram of the 12In:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
3 24 Vdc I/O power segment by external connection
4 2-wire sensor

⚠ 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.

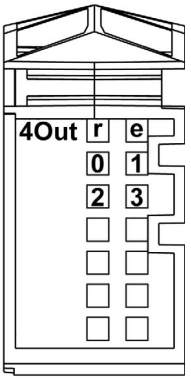
Digital Output 4Out

Overview

The digital 4Out electronic module is equipped with 6 source outputs.

Status LEDs

The following figure shows the LEDs for 4Out:



The following table shows the 4Out status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		Single flash	Detected error for an output channel(1)
e+r	Steady Red / Single Green flash		Invalid firmware
0-3	Yellow	Off	Corresponding output deactivated
		On	Corresponding output activated

NOTE:

(1) The e LED flashes when detecting one of the following errors on output channels:

- Short circuit
- Overload

Output Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

For additional important information about fast output protection, refer to Protecting Outputs from Inductive Load Damage.

The following table provides the characteristics of the 4Out electronic module:

Characteristic	Value
Output channels	4
Wiring type	1 or 2 or 3 wires
Output type	Transistor
Signal type	Source
Output current	0.5 A max. per output
Total output current	2 A max.
Rated output voltage	24 Vdc
Output voltage range	20.4...28.8 Vdc
Voltage drop	0.3 Vdc max. at 0.5 A rated current
Leakage current when switched off	5 µA
Turn on time	300 µs max.
Turn off time	300 µs max.
Output protection	Against short-circuit and overload, thermal protection
Short circuit output peak current	12 A max.
Automatic rearming after short circuit or overload	Yes, 10 ms min. depending on internal temperature
Protection against reverse polarity	Yes

Characteristic		Value
Clamping voltage		Typ. 50 Vdc
Switching frequency	Resistive load	500 Hz Max.
	Inductive load	See the switching inductive load characteristics *(see page 75)*
Isolation	Between input and internal bus	See note [1]
	Between channels	Not isolated

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

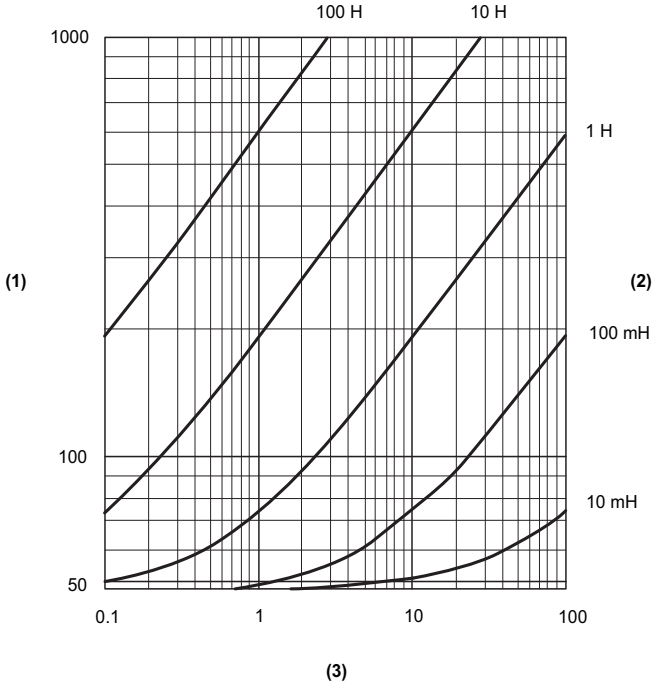
Actuator Supply

The following table provides the actuator supply of the 4Out electronic module:

supply	
Voltage	Power segment supply less voltage drop for internal protection.
Voltage drop for internal protection at 500 mA	2 Vdc max
Actuator supply current (for all powered connected actuators)	500 mA
Internal protection	Overload short circuit

Switching Inductive Load

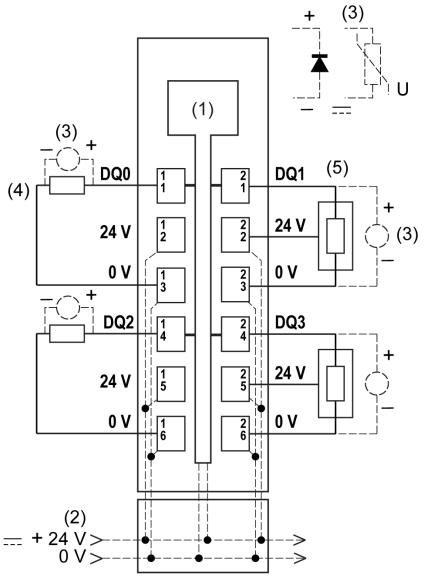
The following curves provide the switching inductive load characteristics for the 4Out electronic module.



1 Coil resistance in Ω
2 Coil inductance
3 Max. operating cycles / second

Wiring Diagram

The following figure shows the wiring diagram of the 4Out:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
3 Inductive load protection
4 2-wire load
5 3-wire load

⚠ 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.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Use the sensor and actuator power supply only for supplying power to sensors or actuators connected to the module.

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

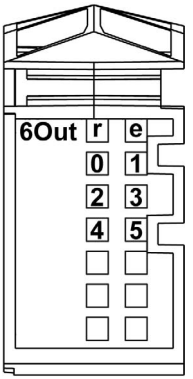
Digital Output 6Out

Overview

The digital 6Out electronic module is equipped with 6 source outputs.

Status LEDs

The following figure shows the LEDs for 6Out:



The following table shows the 6Out status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		Single flash	Detected error for an output channel(1)
e+r	Steady Red / Single Green flash		Invalid firmware
0-5	Yellow	Off	Corresponding output deactivated
		On	Corresponding output activated

NOTE:

(1) The e LED flashes when detecting one of the following errors on output channels:

- Short circuit
- Overload

Output Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

For additional important information about fast output protection, refer to Protecting Outputs from Inductive Load Damage.

The following table provides the characteristics of the 6Out electronic module:

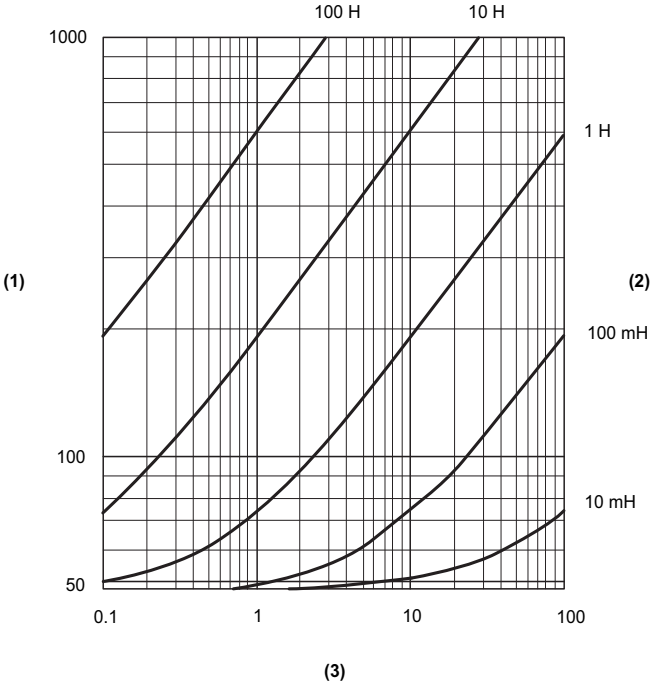
Characteristic	Value
Output channels	6
Wiring type	1 or 2 wires
Output type	Transistor
Signal type	Source
Output current	0.5 A max. per output
Total output current	3 A max.
Rated output voltage	24 Vdc
Output voltage range	20.4...28.8 Vdc
Voltage drop	0.3 Vdc max. at 0.5 A rated current
Leakage current when switched off	5 µA
Turn on time	300 µs max.
Turn off time	300 µs max.
Output protection	Against short-circuit and overload, thermal protection
Short circuit output peak current	12 A max.
Automatic rearming after short circuit or overload	Yes, 10 ms min. depending on internal temperature
Protection against reverse polarity	Yes

Characteristic		Value
Clamping voltage		Typ. 50 Vdc
Switching frequency	Resistive load	500 Hz Max.
	Inductive load	See the switching inductive load characteristics *(see page 75)*
Isolation	Between input and internal bus	See note [1]
	Between channels	Not isolated

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

Switching Inductive Load

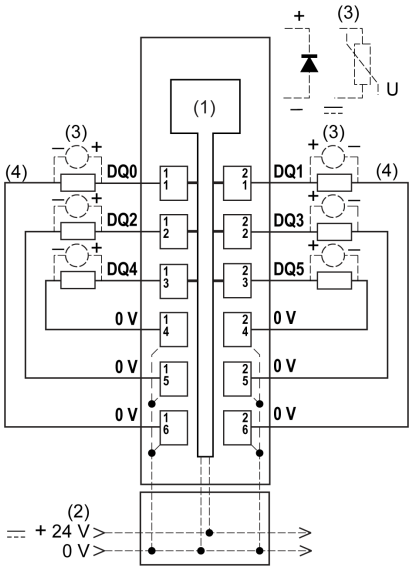
The following curves provide the switching inductive load characteristics for the 6Out electronic module.



1 Coil resistance in Ω
2 Coil inductance
3 Max. operating cycles / second

Wiring Diagram

The following figure shows the wiring diagram of the 6Out:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
3 Inductive load protection
4 2-wire load

⚠ 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.

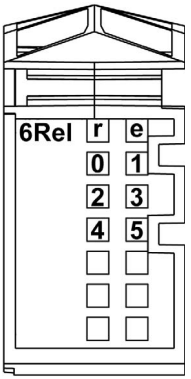
Digital Output Relay 6Rel

Overview

The relay 6Rel electronic module is equipped with 6 relay outputs.

Status LEDs

The following figure shows the LEDs for 6Rel:



The following table shows the 6Rel status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Detected error or reset state
e+r	Steady red / single green flash		Invalid firmware
0-5	Yellow	Off	Corresponding output deactivated
		On	Corresponding output activated

Output Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the characteristics of 6Rel electronic module:

Characteristic		Value
Output channels		6
Wiring type		6 contacts
Contact type		NO (Normally Open)
Output current		30 Vdc / 2 A (Resistive load) 240 Vac / 2 A (cos Φ = 1)
Switching frequency		3600 cycles by hour max.
Relay dielectric maximum voltage		2000 V rms, 50/60 Hz for 1 mn
Maximum switching load		264 Vac / 125 Vdc
Minimum switching load		5 Vdc at 1 mA
Maximum power of filament lamp		1.2 W
Turn on time		12 ms max.
Turn off time		10 ms max.
Protective circuit[2]	Internal	None
	External DC AC	 Flyback diode, RC combination or Varistor RC combination or Varistor
Automatic rearming after short circuit or overload		Yes, 10 ms min. depending on internal temperature

Characteristic		Value
Switching capacity	Minimum	10 mA at 5 Vdc
	Maximum	150 W / 1250 VA
Protection against reverse polarity		Yes
Isolation	Between channels and bus	See note [1]
	Between outputs	Not isolated
Mechanical durability		Typically $2x10^7$ cycles or more

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

[2] Refer to Protecting Outputs from Inductive Load Damage for additional important information on this topic.

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

⚠ WARNING

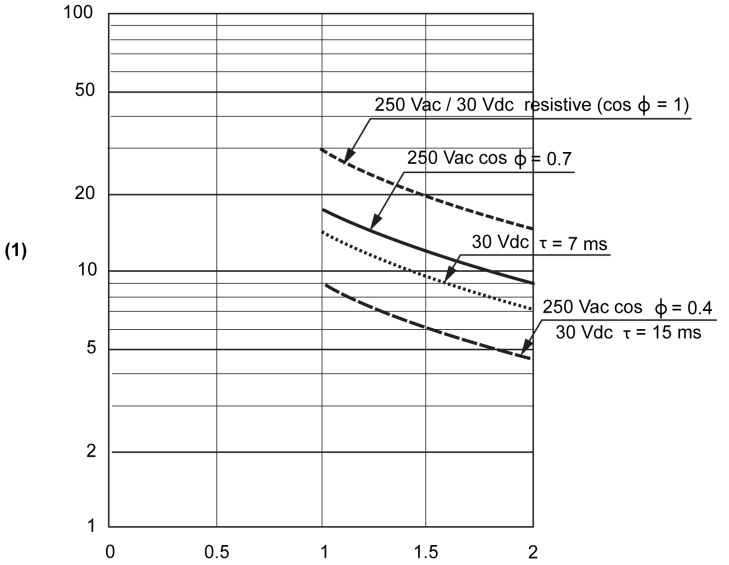
RELAY OUTPUTS WELDED CLOSED

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

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

Electric Durability

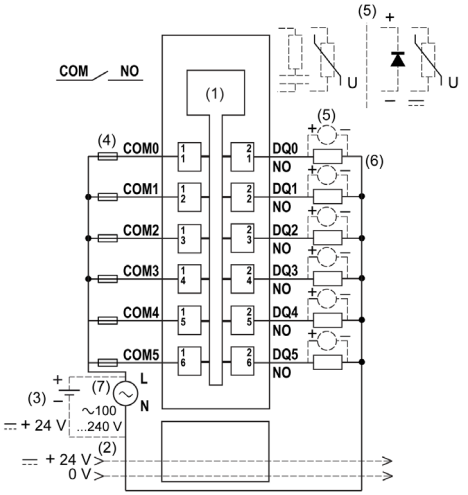
The curves below provide the expected life of the relay contacts for the 6Rel electronic module.



1 Switching procedures (x10^4)
2 Switching current in A

Wiring Diagram

The following figure shows the wiring diagram of the 6Rel:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
3 External isolated power supply 24 Vdc
4 External fuse type T slow-blow 2 A 250 V
5 Inductive load protection
6 2-wire load
7 External power supply 100...240 Vac

⚠ WARNING

POTENTIAL OF OVERHEATING AND FIRE

- Do not connect the modules directly to line voltage.
- Use only isolating PELV systems according to IEC 61140 to supply power to the modules.

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

⚠ 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.

NOTE: Refer to Protecting Outputs from Inductive Load Damage for additional important information on this topic.

Section 4.2
Analog I/O Electronic Modules

Introduction

This section describes the analog I/O electronic modules contained within the Compact I/O modules.

What Is in This Section?

This section contains the following topics:

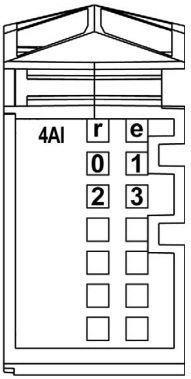
Analog Input 4AI ±10 V

Overview

The analog 4AI ±10 V electronic module is equipped with 4 12-bit inputs.

Status LEDs

The following figure shows LEDs for 4AI ±10 V:



The following table shows the 4AI ±10 V status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Detected error or reset state
		Double Flash	System detected error: ● Scan time overrun ● Synchronization detected error
0-3	Green	Off	Channel not configured or open connection or sensor is disconnected
		On	The analog/digital converter is running, value is available

Input Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the characteristics of the 4AI ±10 V electronic module:

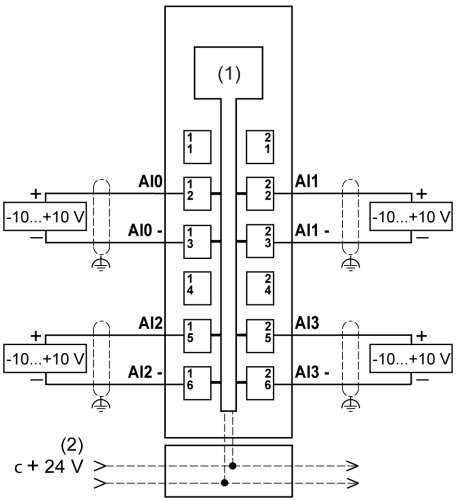
Characteristic	Voltage input
Number of input channels	4
Input range	-10...10 Vdc
Input impedance	20 MΩ min.
Load impedance	-
Sample duration time	20 ms for the whole module 5 ms for one channel
Input type	Differential
Conversion mode	Successive Approximative Register
Input filter	50 ms, not configurable
Input tolerance - maximum deviation at ambient 25° C (77°F)	< 0.08% of the measurement
Input tolerance - temperature drift	0.006% / °C of the measurement
Input tolerance - non linearity	< 0.025% of the full scale (20 V)
Digital resolution	12 bit
Resolution value	2.441 mV
Common mode rejection	DC
	50 Hz
Cable type	Shielded cable required
Crosstalk rejection between channels	70 dB min.

Characteristic	Voltage input
Isolation between channels	Not isolated
Isolation between channels and bus	See note [1].
Permitted input signal	±30 Vdc max.
Input protection	Protection against wiring with 24 Vdc supply voltage
Common mode voltage allowable between channels	±12 Vdc max.

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

Wiring Diagram

The following figure shows the wiring diagram of the 4AI ±10 V:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
U Voltage

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

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

⚠ 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.

For more information, refer to the TM5 System Wiring Rules and Recommendation.

⚠ 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.

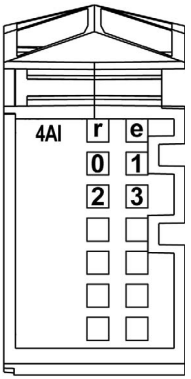
Analog Input 4AI 0-20 mA / 4-20 mA

Overview

The analog 4AI 0-20 mA / 4-20 mA electronic module is equipped with 4 12-bit inputs.

Status LEDs

The following figure shows LEDs for 4AI 0-20 mA / 4-20 mA:



The following table shows the 4AI 0-20 mA / 4-20 mA status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Detected error or reset state
		Double Flash	System detected error: ● Scan time overrun ● Synchronization detected error
0-3	Green	Off	Channel not configured or open connection or sensor is disconnected
		On	The analog/digital converter is running, value is available

Input Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the characteristics of the 4AI 0-20 mA / 4-20 mA electronic module:

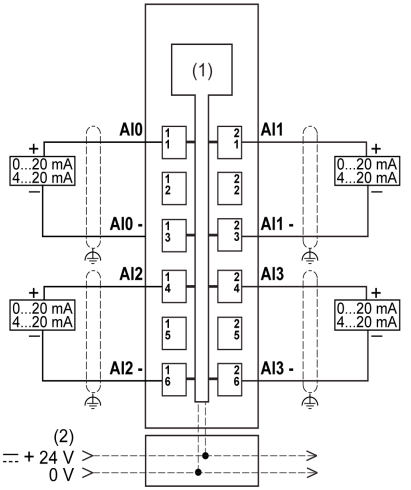
Characteristic	Current input	
Number of input channels	4	
Input range	0...20 mA	4...20 mA
Input impedance	–	
Load impedance	400 Ω max.	
Sample duration time	20 ms for the whole module 5 ms for one channel	
Input type	Differential	
Conversion mode	Successive Approximative Register	
Input filter	Low pass 3rd order / cut-off frequency 1 kHz	
Input tolerance - maximum deviation at ambient 25° C (77°F)	< 0.08% of the measurement	< 0.1% of the measurement
Input tolerance - temperature drift	0.009% / °C of the measurement	0.0113% / °C of the measurement
Input tolerance - non linearity	< 0.05% of the full scale (20 mA)	
Digital resolution	12 bit	
Resolution value	4.883 µA	
Common mode rejection	70 dB min.	
	70 dB min.	
Cable type	Shielded cable required	
Crosstalk rejection between channels	70 dB min.	

Characteristic	Current input
Isolation between channels	Not isolated
Isolation between channels and bus	See note [1].
Permitted input signal	±50 mA max.
Input protection	–
Common mode voltage allowable between channels	–

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

Wiring Diagram

The following figure shows the wiring diagram of the 4AI 0-20 mA / 4-20 mA:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases

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

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

⚠ 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.

For more information, refer to the TM5 System Wiring Rules and Recommendation.

⚠ 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.

Analog Input 4AI ±10 V / 0-20 mA

Overview

The analog 4AI ±10 V / 0-20 mA electronic module is equipped with 4 12-bit inputs.

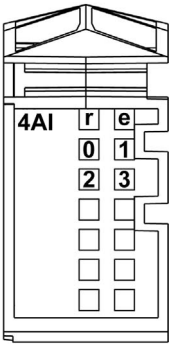
Each channel is capable of converting either current or voltage. There are different terminal connection points for each type of signal.

It is necessary to configure the desired type of input signal:

- -10...+10 Vdc voltage signal (default)
- 0...20 mA current signal

Status LEDs

The following figure shows LEDs for 4AI ±10 V / 0-20 mA:



The following table shows the 4AI ±10 V / 0-20 mA status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Detected error or reset state
		Double Flash	System detected error: ● Scan time overrun ● Synchronization detected error
0-3	Green	Off	Channel not configured or open connection or sensor is disconnected
		On	The analog/digital converter is running, value is available

Input Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the characteristics of the 4AI ±10 V / 0-20 mA electronic module:

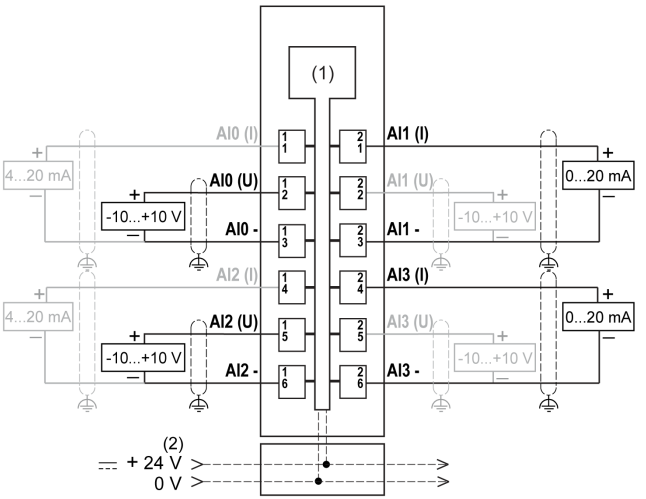
Characteristic	Voltage input	Current input
Number of input channels	4	
Input range	-10... +10 Vdc	0...20 mA
Input impedance	20 MΩ min.	-
Load impedance	-	400 Ω max.
Sample duration time	400 µs for all inputs without filtering 1 ms for all inputs with filtering	
Input type	Differential	
Conversion mode	Successive Approximative Register	
Input filter	Low pass 3rd order / cut-off frequency 1 kHz	
Input tolerance - maximum deviation at ambient 25° C (77°F)	< 0.08% of the measurement	< 0.08% of the measurement
Input tolerance - temperature drift	0.006% / °C of the measurement	0.009% / °C of the measurement
Input tolerance - non linearity	< 0.025% of the full scale (20 V)	< 0.05% of the full scale (20 mA)
Digital resolution	12 bits + sign	12 bits
Resolution value	2.441 mV	4.883 µA
Common mode rejection	DC	70 dB min.
	50 Hz	70 dB min.

Characteristic	Voltage input	Current input
Cable type	Shielded cable required	
Crosstalk rejection between channels	70 dB min.	
Isolation between channels	Not isolated	
Isolation between channels and bus	See note [1].	
Permitted input signal	±30 Vdc max.	±50 mA max.
Input protection	Protection against wiring with 24 Vdc supply voltage	
Common mode voltage allowable between channels	±12 Vdc max.	

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

Wiring Diagram

The following figure shows the wiring diagram of the 4AI ±10 V / 0-20 mA:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
I Current
U Voltage

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

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

⚠ 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.

For more information, refer to the TM5 System Wiring Rules and Recommendation.

⚠ 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.

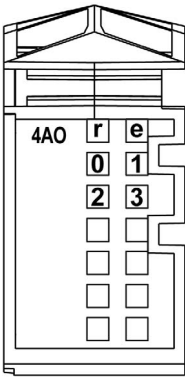
Analog Output 4AO ±10 V

Overview

The analog 4AO ±10 V electronic module is equipped with 4 12-bit outputs.

Status LEDs

The following figure shows LEDs for 4AO ±10 V:



The following table shows the 4AO ±10 V status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Detected error or reset state
0-3	Yellow	Off	Value = 0
		On	Value ≠ 0

Output Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the characteristics of the 4AO ±10 V electronic module:

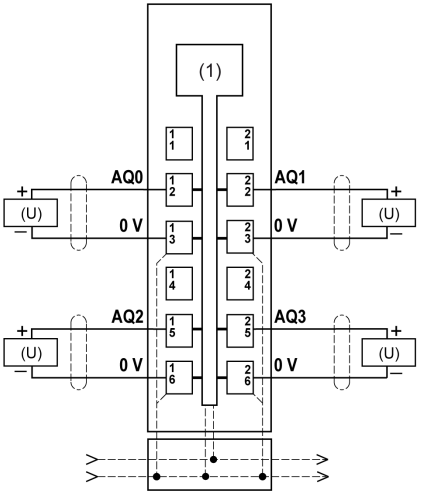
Characteristic	Voltage output
Number of output channels	4
Output range	-10...10 Vdc
Output impedance	1 kΩ min.
Load impedance	-
Sample duration time	20 ms for the whole module 5 ms for 1 channel
Output type	Differential
Response time for output change	1 ms max.
Output tolerance - maximum deviation at ambient 25° C (77°F)	< 0.15% of the measurement
Output tolerance - temperature drift	0.011% / °C of the measurement
Output tolerance - non linearity	< 0.1% of the full scale (20 V)
Output tolerance - maximum deviation caused by load change	< 0.02% from 10 MΩ το 1 KΩ, resistive
Digital resolution	11 bit + sign
Resolution value	4.883 mV
Cable type	Shielded cable required
Isolation between channels	Not isolated

Characteristic	Voltage output
Isolation between channels and bus	See note [1].
Output protection	Short circuit protection: current limitation is 40 mA

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

Wiring Diagram

The following figure shows the wiring diagram of the 4AO ±10 V:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
U Voltage

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

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

⚠ 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.

For more information, refer to the TM5 System Wiring Rules and Recommendation.

⚠ 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.

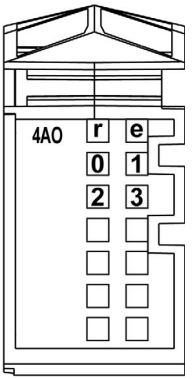
Analog Output 4AO 0-20 mA

Overview

The analog 4AO 0-20 mA electronic module is equipped with 4 12-bit outputs.

Status LEDs

The following figure shows LEDs for 4AO 0-20 mA:



The following table shows the 4AO 0-20 mA status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Detected error or reset state
0-3	Yellow	Off	Value = 0
		On	Value ≠ 0

Output Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the characteristics of the 4AO 0-20 mA electronic module:

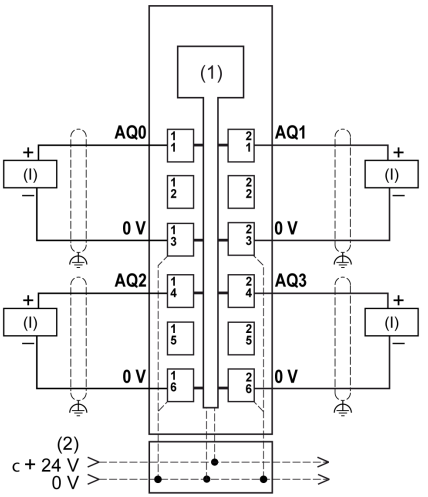
Characteristic	Current output
Number of output channels	4
Output range	0...20 mA
Output impedance	-
Load impedance	500 Ω max.
Sample duration time	20 ms for the whole module 5 ms for 1 channel
Output type	Differential
Response time for output change	1 ms max.
Output tolerance - maximum deviation at ambient 25° C (77°F)	< 0.2% of the measurement
Output tolerance - temperature drift	0.013% / °C of the measurement
Output tolerance - non linearity	< 0.1% of the full scale (20 mA)
Output tolerance - maximum deviation caused by load change	< 0.5% from 1 Ω το 500 Ω, resistive
Digital resolution	12 bit
Resolution value	4.883 µA
Cable type	Shielded cable required
Isolation between channels	Not isolated

Characteristic	Current output
Isolation between channels and bus	See note [1].
Output protection	Short circuit protection: current limitation is 40 mA

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

Wiring Diagram

The following figure shows the wiring diagram of the 4AO 0-20 mA:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
I Current

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

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

⚠ 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.

For more information, refer to the TM5 System Wiring Rules and Recommendation.

⚠ 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.

Analog Output 2AO ±10 V / 0-20 mA

Overview

The analog 2AO ±10 V / 0-20 mA electronic module is equipped with 2 12-bit outputs.

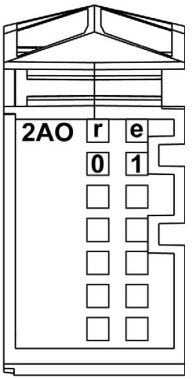
Each channel is capable of converting either current or voltage. There are different terminal connection points for each type of signal.

It is necessary to configure the desired type of output signal:

- -10...+10 Vdc (default)
- 0...20 mA

Status LEDs

The following figure shows LEDs for 2AO ±10 V / 0-20 mA:



The following table shows the 2AO ±10 V / 0-20 mA status LEDs:

LEDs	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Detected error or reset state
0-1	Yellow	Off	Value = 0
		On	Value ≠ 0

Output Characteristics

⚠ DANGER

FIRE HAZARD

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

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

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

The following table provides the characteristics of the 2AO ±10 V / 0-20 mA electronic module:

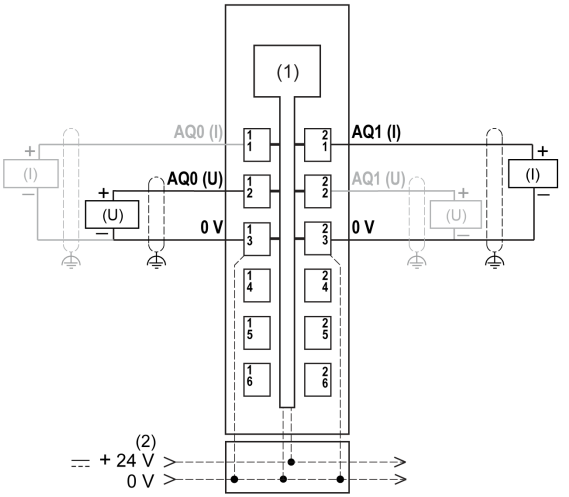
Characteristic	Voltage output	Current output
Number of output channels	2	
Output range	-10... +10 Vdc	0...20 mA
Output impedance	1 kΩ min.	-
Load impedance	-	500 Ω max.
Sample duration time	200 µs for all outputs	
Output type	Differential	
Response time for output change	1 ms max.	
Output tolerance - maximum deviation at ambient 25° C (77°F)	< 0.15% of the measurement	
Output tolerance - temperature drift	0.02% / °C of the measurement	
Output tolerance - non linearity	< 0.007% of the full scale (20 V)	< 0.007% of the full scale (20 mA)
Output tolerance - maximum deviation caused by load change	< 0.02% from 10 MΩ το 1 KΩ, resistive	< 0.5% from 1 Ω το 500 Ω, resistive
Digital resolution	12 bits + sign	12 bits
Resolution value	4.882 mV	9.766 µA
Cable type	Shielded cable required	
Isolation between channels	Not isolated	

Characteristic	Voltage output	Current output
Isolation between channels and bus	See note [1].	
Output protection	Short circuit protection: current limitation is 40 mA	

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

Wiring Diagram

The following figure shows the wiring diagram of the 2AO ±10 V / 0-20 mA:



1 Internal electronics
2 24 Vdc I/O power segment integrated into the bus bases
I Current
U Voltage

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

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

⚠ 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.

For more information, refer to the TM5 System Wiring Rules and Recommendation.

⚠ 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.

Section 4.3
Dummy Module

Dummy Module

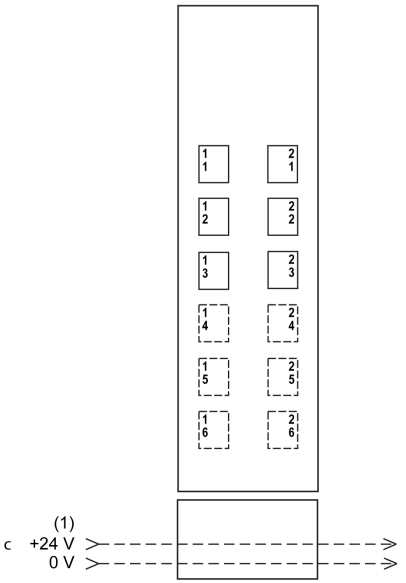
General Information

The dummy module is a non-functional module.

General Characteristics

The characteristics of the dummy module are described in environmental characteristics *(see page 23)*.

Wiring Diagram



1 24 Vdc I/O power segment integrated into the bus bases

Glossary

!

%

According to the IEC standard, % is a prefix that identifies internal memory addresses in the logic controller to store the value of program variables, constants, I/O, and so on.

A

analog input

Converts received voltage or current levels into numerical values. You can store and process these values within the logic controller.

analog output

Converts numerical values within the logic controller and sends out proportional voltage or current levels.

C

CAN

(*controller area network*) A protocol (ISO 11898) for serial bus networks, designed for the interconnection of smart devices (from multiple manufacturers) in smart systems and for real-time industrial applications. Originally developed for use in automobiles, CAN is now used in a variety of industrial automation control environments.

control network

A network containing logic controllers, SCADA systems, PCs, HMI, switches, ...

Two kinds of topologies are supported:

- flat: all modules and devices in this network belong to same subnet.
- 2 levels: the network is split into an operation network and an inter-controller network.

These two networks can be physically independent, but are generally linked by a routing device.

CSA

(*Canadian standards association*) The Canadian standard for industrial electronic equipment in hazardous environments.

D

digital I/O

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

DIN

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

E

electronic module

In a programmable controller system, most electronic modules directly interface to the sensors, actuators, and external devices of the machine/process. This electronic module is the component that mounts in a bus base and provides electrical connections between the controller and the field devices. Electronic modules are offered in a variety of signal levels and capacities. (Some electronic modules are not I/O interfaces, including power distribution modules and transmitter/receiver modules.)

EN

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

encoder

A device for length or angular measurement (linear or rotary encoders).

equipment

A part of a machine including sub-assemblies such as conveyors, turntables, and so on.

Ethernet

A physical and data link layer technology for LANs, also known as IEEE 802.3.

F

FAST I/O

FAST input/output Specific I/O modules with some electrical features (for example, response time) while the treatment of these channels are done directly by the controller

firmware

Represents the BIOS, data parameters, and programming instructions that constitute the operating system on a controller. The firmware is stored in non-volatile memory within the controller.

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.

IP 67

(*ingress protection*) The protection classification according to IEC 60529. IP 67 modules are protected against ingress of dust, contact, and water up to an immersion depth of 1 m.

M

ms

(*millisecond*)

N

network

A system of interconnected devices that share a common data path and protocol for communications.

T

terminal block

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

U

UL

(*underwriters laboratories*) A US organization for product testing and safety certification.

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W