

PacDrive TM5

Expert Modules (High Speed Counter)

Hardware Guide

11/2018



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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.

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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.

QUALIFICATION OF PERSONNEL

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

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

INTENDED USE

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

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

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

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

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

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

About the Book



At a Glance

Document Scope

This manual describes the hardware implementation of the PacDrive TM5 expert modules. It provides part descriptions, specifications, wiring diagrams, installation and setup for PacDrive TM5 expert modules.

Validity Note

This document has been updated for the release of EcoStruxure™ Machine Expert V1.0.

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

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. <ul style="list-style-type: none">● 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 data sheet.
6	To save or print a data sheet as a .pdf file, click Download XXX product datasheet .


The characteristics that are presented in 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	EIO0000000420 (Eng) EIO0000000421 (Fre) EIO0000000422 (Ger) EIO0000000423 (Spa) EIO0000000424 (Ita) EIO0000000425 (Chs)
Modicon Flexible TM5 / TM7 System - System Planning and Installation Guide	EIO0000000426 (Eng) EIO0000000427 (Fre) EIO0000000428 (Ger) EIO0000000429 (Spa) EIO0000000430 (Ita) EIO0000000431 (Chs)
TM5SE1IC20005 / TM5SE1MISC20005 Instruction Sheet	QGH70211
TM5 Incremental Encoder Input and Output Device Objects and Parameters	EIO0000002708 (Eng)

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

Terminology Derived from Standards

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

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

Among others, these standards include:

Standard	Description
IEC 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2015	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2005	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2016	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

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

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

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

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

Part I

TM5 Expert (HSC) General Overview

What Is in This Part?

This part contains the following chapters:

Chapter	Chapter Name	Page
1	TM5 Expert (HSC) General Overview	15
2	TM5 System General Rules for Implementing	21

Chapter 1

TM5 Expert (HSC) General Overview

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
General Description	16
Physical Description	17

General Description

Introduction

The range of expert expansion electronic modules includes the High Speed Counter (HSC) electronic modules.

HSC Electronic Module Features

The HSC electronic modules are used for counting functions and position detection.

The following table shows the HSC electronic modules features:

Reference	Number Channels	Input Type	Encoder Input	Resolution	Input Frequency
TM5SE1IC20005 <i>(see page 37)</i>	1	Incremental	5 V Symmetrical	16/32 bits	maximum 4 MHz

Reference	Number Channels	Output Type	Encoder Output	Resolution	Output Frequency
TM5SE1MISC2000 5 <i>(see page 47)</i>	1	Incremental	5 V Symmetrical	16/32 bits	4 MHz

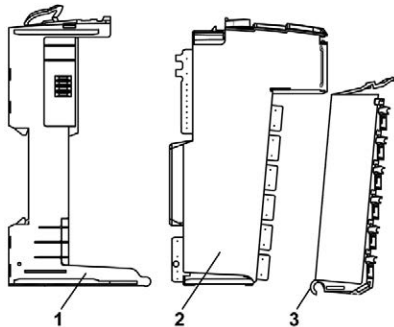
Physical Description

Introduction

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

Elements

The following illustration shows the elements of a slice.



- 1 Bus base
- 2 Electronic module
- 3 Terminal block

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

NOTICE

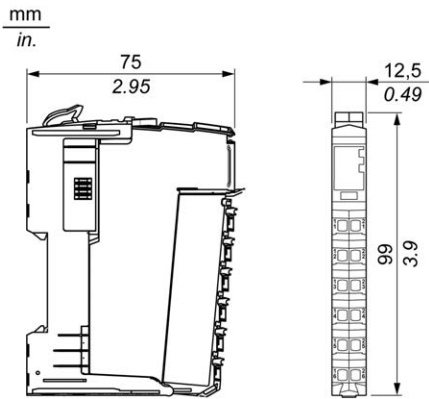
ELECTROSTATIC DISCHARGE

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

Failure to follow these instructions can result in equipment damage.

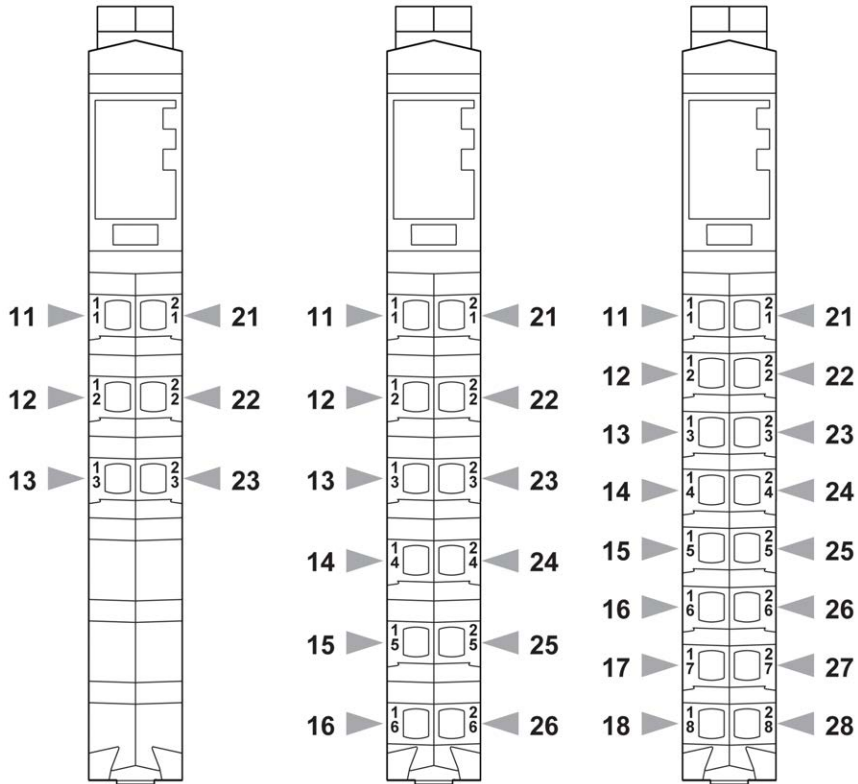
Dimensions

The following illustration shows the dimensions of a slice:



Pin Assignment

The following illustration shows the pin assignments respectively for the 6-pin, 12-pin and the 16-pin terminal blocks:



Accessories

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

Labeling

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

Chapter 2

TM5 System General Rules for Implementing

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Installation and Maintenance Requirements	22
Wiring Best Practices	24
TM5 Environmental Characteristics	28
Installation Guidelines	30
Hot Swapping Electronic Modules	31

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
<p>UNINTENDED EQUIPMENT OPERATION</p> <ul style="list-style-type: none"> ● Only use software approved by Schneider Electric for use with this equipment. ● Update your application program every time you change the physical hardware configuration. <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p>

Operating Environment

 WARNING
<p>UNINTENDED EQUIPMENT OPERATION</p> <p>Install and operate this equipment according to the conditions described in the Environmental Characteristics.</p> <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p>

Installation Considerations

 WARNING
<p>UNINTENDED EQUIPMENT OPERATION</p> <ul style="list-style-type: none"> ● 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.). <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p>

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 point¹.
- Route communication and I/O cables separately from power cables.

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





¹Multipoint 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 (*see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide*) to ground the shielded cables.

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

$\frac{\text{mm}}{\text{in.}}$ 				
mm ²	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:

$\frac{\text{mm}}{\text{in.}}$ 			
mm ²	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 current capacity of the I/O channels and power supplies.
- For relay output (2 A) wiring, use conductors of at least 0.5 mm² (AWG 20) with a temperature rating of at least 80 °C (176 °F).
- For common conductors of relay output wiring (7 A), or relay output wiring greater than 2 A, use conductors of at least 1.0 mm² (AWG 16) with a temperature rating of at least 80 °C (176 °F).

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

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

  **DANGER**

LOOSE WIRING CAUSES ELECTRIC SHOCK

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

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

TM5 Terminal Block

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

  **DANGER**

ELECTRIC SHOCK OR UNINTENDED EQUIPMENT OPERATION

Connect the terminal blocks to their designated location.

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

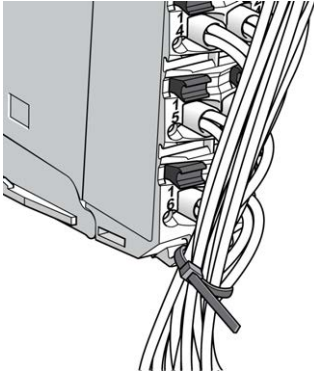
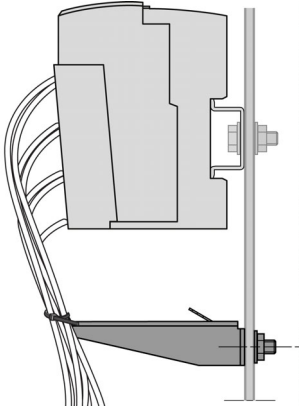
NOTE: To help prevent a terminal block from being inserted incorrectly, ensure that each terminal block and electronic module is clearly and uniquely coded (*see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide*).

TM5 Strain Relief Using Cable Tie

There are 2 methods to reduce the stress on cables:

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

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

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

⚠ WARNING

ACCIDENTAL DISCONNECTION FROM PROTECTIVE GROUND (PE)

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

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

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	Specification	
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	No	
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

Characteristic	Specification
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

Electromagnetic Susceptibility

The table below provides the TM5 System electromagnetic susceptibility specifications:

Characteristic	Specification	Range
Electrostatic discharge	IEC/EN 61000-4-2	8 kV (air discharge) 4 kV (contact discharge)
Electromagnetic fields	IEC/EN 61000-4-3	10 V/m (80 MHz...2 GHz) 10 V/m (80 MHz...2.7 GHz) ⁽¹⁾
Fast transients burst	IEC/EN 61000-4-4	Power lines: 2 kV I/O: 1 kV Shielded cable: 1 kV Repetition rate: 5 ⁽¹⁾ and 100 KHz
Surge immunity 24 Vdc circuit	IEC/EN 61000-4-5	1 kV in common mode 0.5 kV in differential mode
Surge immunity 230 Vac circuit		2 kV in common mode 1 kV in differential mode
Induced electromagnetic field	IEC/EN 61000-4-6	10 V _{eff} (0.15...80 MHz)
Conducted emission	EN 55011 (IEC/CISPR11)	150...500 kHz, quasi peak 79 dB μ V
		500 kHz...30 MHz, quasi peak 73 dB μ V
Radiated emission	EN 55011 (IEC/CISPR11)	30...230 MHz, 10 m@40 dB μ V/m
		230 MHz...1 GHz, 10 m@47 dB μ V/m
(1) Applies for TM5SE1IC20005 and TM5SE1MISC20005.		

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 <i>Enclosing the TM5 System (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)</i> .
Electronic modules installation	Refer to: <ul style="list-style-type: none"> ● <i>TM5 Association Table (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)</i>. ● <i>Expanding the TM5 System (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)</i>.
Accessories installation	Refer to the <i>Installation of Accessories (see PacDrive TM5 / TM7 Flexible System, System Planning and Installation Guide)</i> .

Hot Swapping Electronic Modules


Definition

Hot swapping is the ability to remove an I/O electronic module from its bus base and then replace it with an identical electronic module while the TM5 System is under power without disrupting the normal operations of the controller. When the electronic module is returned to its bus base or replaced with another electronic module with the same reference, it starts to operate again.

Hot Swapping Considerations

Before initiating a hot swap operation, confirm that the electronic module type is approved for hot swapping (*see page 33*).

When removing or inserting an I/O module while power is applied, remove and insert the electronic module by hand. Do not use tools to hot swap modules because they may come into contact with hazardous voltages. Also, remove any locking clips and the terminal block before removing the electronic module from its bus base. Hot swapping is only allowed when replacing identical electronic modules.

 **DANGER**

EXPLOSION OR ELECTRIC SHOCK

- Only perform a hot swap operation in locations known and confirmed to be non-hazardous.
- Use only your hands.
- Do not use any metal tools.
- Do not disconnect any wires from the terminal block.
- Only replace an electronic module with an identical reference.

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

NOTE: Only the electronic module is hot swap-able. Do not attempt a hot swap operation on the bus base, or on electronic modules that are integrated with their bus bases such as the compact I/O.

You need to understand and plan for the effects of hot-swapping certain modules. Hot-swapping modules that control power distribution to other modules, for example, can impact your machine or process. Power Distribution modules, Interface Power Distribution Modules, Common Distribution modules, Field Bus Interface Modules, and Transmitter and Receiver modules all either distribute power or communications to other electronic modules. Disconnecting the connector to these modules will interrupt power or communications to the modules they service.

For example, some Power Distribution Modules (PDMs) provide power to both the TM5 power bus and 24 Vdc I/O power segment. It is possible that you may need to replace the PDM because one service is inoperable, but not both. In this case, hot-swapping the PDM would interrupt the service that is still operating, and would interrupt power to the modules drawing power from that service.

I/O configurations that employ Common Distribution modules require careful consideration when wiring is restricted by short wire lengths. It may be the case that in order to hot-swap an electronic module that has become inoperable, you need to disconnect the connector of the Common module servicing it. Further, that same Common module may be connected to modules or devices other than the module you wish to hot-swap. Disconnecting the Common module in this case would necessarily interrupt the supply to the unaffected modules and/or devices. Be sure that you know what I/O slices or devices are connected to the Common module, and the impact that this disconnection would have on your machine or process before attempting a hot-swap operation.

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.

NOTE: Be sure you thoroughly understand the effects of a hot-swap operation on all modules and connected devices as they relate to your machine or process.

Modules that are not Hot Swap-able

Electronic modules that can not be hot swapped under any circumstances include:

TM5	Electronic Modules Type	Reasons
Controller	PCI communication	The replacement of the PCI communication module requires a power cycle before it will be recognized by the controller.
	Controller Power Distribution Module	These modules are not removable.
	Embedded I/O Modules	
Field bus interface	CANopen interface module	The replacement of the CANopen interface module depends on CANopen master architecture. Refer to the Generic CANopen Implementation Guide and documentation associated with the CANopen master.
Compact I/O	I/O modules	These modules are not removable.

Part II

TM5 System Expert (HSC)Electronic Modules

What Is in This Part?

This part contains the following chapters:

Chapter	Chapter Name	Page
3	TM5SE1IC20005 Incremental Encoder Input Module	37
4	TM5SE1MISC20005 Incremental Encoder Output Module	47

Chapter 3

TM5SE1IC20005 Incremental Encoder Input Module

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
TM5SE1IC20005 Presentation	38
TM5SE1IC20005 Characteristics	41
TM5SE1IC20005 Wiring Diagram	44

TM5SE1IC20005 Presentation

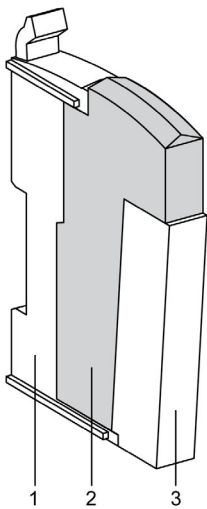
Main Characteristics

The following table describes the main characteristics of the digital counter module TM5SE1IC20005:

Main characteristics	
Number of digital inputs	2
Number of input channels	1
Encoder type	Incremental
Input counting frequency	Maximum 4 MHz using 4 x evaluation
Encoder supply	24 Vdc
Encoder input	5 V symmetrical
Counter-functions	1 ABR incremental encoder 5 V
Resolution	16/32-bit

Ordering Information

The illustration below shows the TM5SE1IC20005:



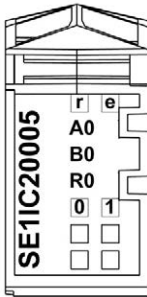
The following table shows the references for the terminal block and the bus bases associated with the TM5SE1IC20005:

Number	Reference	Description	Color
1	TM5ACBM11	Bus base	White
	or TM5ACBM15	Bus base with address setting	White
2	TM5SE1IC20005	Electronic module	White
3	TM5ACTB12	Terminal block, 12 pins	White

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

Status LEDs

The following illustration describes the LEDs for TM5SE1IC20005:



The table shows the TM5SE1IC20005 status LEDs:


LED	Color	Status	Description
r	Green	Off	No power supply
		Single flash	Reset state
		Double flash	Boot state (during firmware update) Depending on the configuration, a firmware update can take up to several minutes.
		Flashing	Preoperational state
		On	Normal operation

LED	Color	Status	Description
e	Red	Off	OK or no power supply.
		On	Error detected or reset state.
		Single flash	The encoder monitor has detected a line error on the encoder inputs. The status bits must be evaluated in order to provide a more detailed definition of this detected error. The following error states are detected: <ul style="list-style-type: none">● Broken connection (up to 250 kHz input frequency)● Short-circuit or insufficient voltage level
A0	Green	On	Input state of counter-input A.
B0	Green	On	Input state of counter-input B.
R0	Green	On	Input state of reference pulse R.
0-1	Green	On	Input state of the corresponding digital input.

TM5SE1IC20005 Characteristics

Introduction

This is the description characteristics for the TM5SE1IC20005 electronic module. See also Environmental Characteristics (*see page 28*).

 WARNING
UNINTENDED EQUIPMENT OPERATION
Do not exceed any of the rated values specified in the environmental and electrical characteristics tables.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

General Characteristics

The following table describes the general characteristics of the TM5SE1IC20005 electronic module:

General characteristics		
Rated power supply voltage		24 Vdc
Power supply range		20.4...28.8 Vdc
Status indicators		I/O function per channel, operating state, module status
Diagnostics	Module run/error	Yes, using status LED and software
Power consumption	Bus	0.01 W
	Internal I/O	1.0 W
Additional power dissipation caused by the actuators (resistive) [W]		–
Type of signal lines		Shielded cables must be used for all signal lines.
Electrical isolation	Channel - Bus	Yes
	Channel - Channel	No
Weight		25 g (0.88 oz)
ID code for firmware update		46955 dec

Input Characteristics

The table describes the input characteristics of the TM5SE1IC20005 electronic module:

Input characteristics		
Number of digital inputs		2
Connection type		3-wire connections
Rated input voltage		24 Vdc
Input voltage range		20.4...28.8 Vdc
Input current at 24 Vdc		approx. 3.3 mA
Input impedance		7.03 k Ω
Input circuit		Sink
Input filter	Hardware	≤ 30 ns
	Software	–
Switching threshold	Low	<5 Vdc
	High	>15 Vdc
Isolation voltage between channels and bus ¹		See note.

NOTE¹: The isolation of the electronic module is 500 Vac RMS between the electronics power by the TM5 bus and those powered by 24 Vdc I/O power segment connected to the module. In practice, the electronic module is installed in the bus base, and there is a bridge between the TM5 power bus and the 24 Vdc I/O power segment. The two power circuits reference the same functional ground (FE) through specific components designed to reduce effects of electromagnetic interference. These components are rated at 30 Vdc or 60 Vdc. This effectively reduces isolation of the entire system from the 500 Vac RMS.

ABR Incremental Encoder Characteristics

The table describes the ABR incremental encoder characteristics of the TM5SE1IC20005 electronic module:

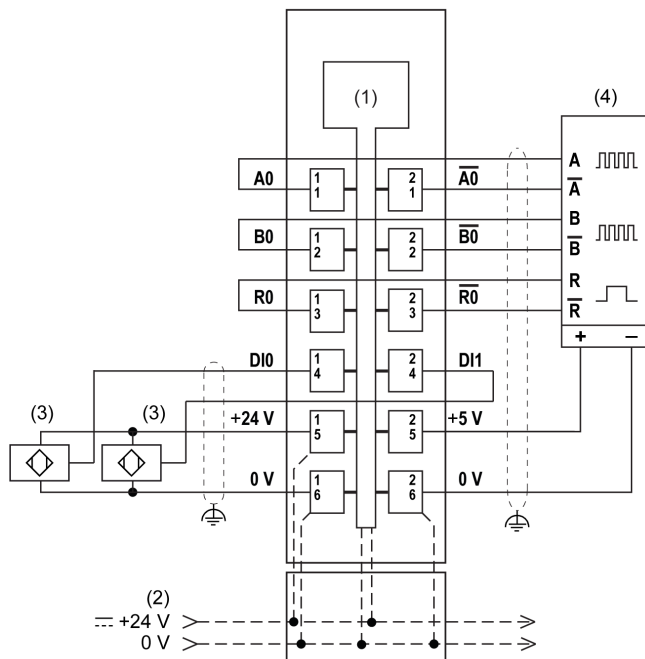
Encoder characteristics		
Encoder supply	5 Vdc	±5 %, module-internal, maximum 300 mA
	24 Vdc	Module-internal, maximum 300 mA
Input filter	Hardware	≤ 30 ns
	Software	–
Common-mode range		$-10\text{ V} \leq V_{CM} \leq +13.2\text{ V}$
Overload behavior of the encoder supply		Short circuit protection, overload protection
Isolation voltage between encoder and bus ¹		See note.

NOTE¹: The isolation of the electronic module is 500 Vac RMS between the electronics power by the TM5 bus and those powered by 24 Vdc I/O power segment connected to the module. In practice, the electronic module is installed in the bus base, and there is a bridge between the TM5 power bus and the 24 Vdc I/O power segment. The two power circuits reference the same functional ground (FE) through specific components designed to reduce effects of electromagnetic interference. These components are rated at 30 Vdc or 60 Vdc. This effectively reduces isolation of the entire system from the 500 Vac RMS.

TM5SE1IC20005 Wiring Diagram

Wiring Diagram

The following illustration presents the wiring diagram for the TM5SE1IC20005:



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

⚠ 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.

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 point¹.
- Route communication and I/O cables separately from power cables.

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

¹Multipoint 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.

WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

Chapter 4

TM5SE1MISC20005 Incremental Encoder Output Module

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
TM5SE1MISC20005 Presentation	48
TM5SE1MISC20005 Characteristics	51
TM5SE1MISC20005 Wiring Diagram	54
TM5SE1MISC20005 Output Circuit Diagram	56

TM5SE1MISC20005 Presentation

Overview

The digital signal processor module TM5SE1MISC20005 is used for encoder emulation, frequency inverters, or servo axes with the speed follow function can follow a real or virtual master axis.

The TM5SE1MISC20005 module provides the following features:

- 3 digital 5 V channels, configurable as inputs or outputs
- 2 digital 24 V input channels
- Encoder evaluation (A/B) with one reference pulse

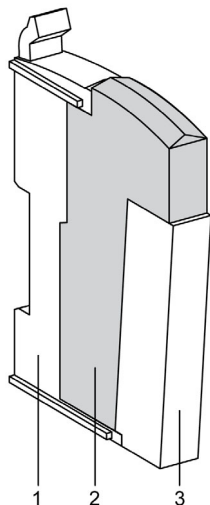
Main Characteristics

The following table describes the main characteristics of the digital signal processor module TM5SE1MISC20005:

Main characteristics	
Number of digital inputs	2
Number of input channels	1
Encoder type	Incremental
Output counting frequency	maximum 4 MHz using 4 x evaluation
Encoder supply	24 Vdc
Encoder output	5 V symmetrical
Counter functions	Encoder emulation (A/B) with one reference pulse
Resolution	16/32-bit

Ordering Information

The illustration below shows the TM5SE1MISC20005:



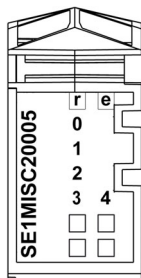
The following table shows the references for the terminal block and the bus bases associated with the TM5SE1MISC20005:

Number	Reference	Description	Color
1	TM5ACBM11 or TM5ACBM15	Bus base Bus base with address setting	White White
2	TM5SE1MISC20005	Electronic module	White
3	TM5ACTB12	Terminal block, 12 pins	White

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

Status LEDs

The following illustration describes the LEDs for TM5SE1MISC20005:



The table shows the TM5SE1MISC20005 status LEDs:

LED	Color	Status	Description
r	Green	Off	No power supply
		Single flash	Reset state
		Double flash	Boot state (during firmware update) Depending on the configuration, a firmware update can take up to several minutes.
		Flashing	Preoperational state
		On	Normal operation
e	Red	Off	OK or no power supply
		On	Error detected or reset state
		Single flash	Input / output error detected.
		Double flash	System error detected.
		Triple flash	I/O error and system error occur together.
0-4	Green	On	Status of the corresponding digital signal.

TM5SE1MISC20005 Characteristics

Introduction

This is the description characteristics for the TM5SE1MISC20005 electronic module. See also Environmental Characteristics (*see page 28*).

WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

General Characteristics

The following table describes the general characteristics of the TM5SE1MISC20005 electronic module:

General characteristics		
Rated power supply voltage		24 Vdc
Power supply range		20.4...28.8 Vdc
Power consumption	Bus	0.01 W
	Internal I/O	1.5 W
Additional power dissipation caused by the actuators (resistive) [W]		–
Type of signal lines		Shielded cables must be used for all signal lines.
Electrical isolation	Channel - Bus	Yes
	Channel - Channel	No
Weight		25 g (0.88 oz)
ID code for firmware update		41063 dec

Digital Input Characteristics 24 Vdc

The table describes the input characteristics of the TM5SE1MISC20005 electronic module:

Digital Inputs 24 Vdc		
Input voltage range		20.4...28.8 Vdc
Input current at 24 Vdc		approx. 3.3 mA
Input resistance		7.19 k Ω
Switching threshold	Low	<5 Vdc
	High	>15 Vdc
Nominal voltage		24 Vdc
Input circuit		Sink
Input filter	Hardware	$\leq 2 \mu\text{s}$
	Software	–
Isolation voltage between channels and bus ¹		See note.

NOTE¹: The isolation of the electronic module is 500 Vac RMS between the electronics power by the TM5 bus and those powered by 24 Vdc I/O power segment connected to the module. In practice, the electronic module is installed in the bus base, and there is a bridge between the TM5 power bus and the 24 Vdc I/O power segment. The two power circuits reference the same functional ground (FE) through specific components designed to reduce effects of electromagnetic interference. These components are rated at 30 Vdc or 60 Vdc. This effectively reduces isolation of the entire system from the 500 Vac RMS.

Digital Output Characteristics 5 Vdc

The table describes the output characteristics of the TM5SE1MISC20005 electronic module:

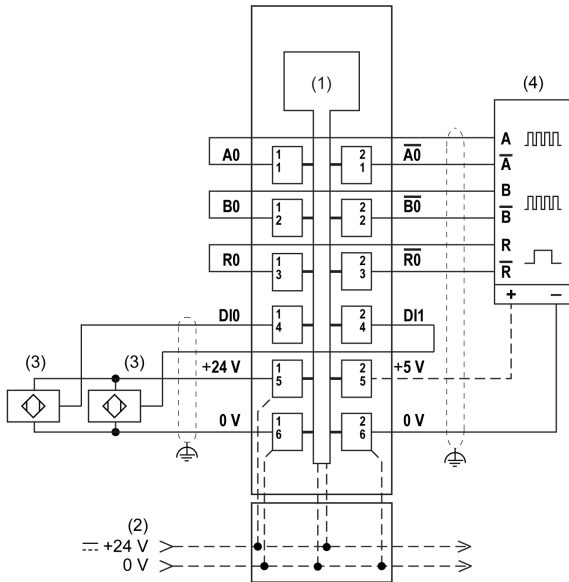
Digital Outputs 5 Vdc	
Output circuit	Source
Output protection	Short circuit protection
Design	<ul style="list-style-type: none"> ● Push ● Pull ● Push-Pull
Diagnostic status	Readable output
Isolation voltage between channel and bus ¹	See note.
Switching voltage	5 Vdc differential signal, RS-485 standard
Function	Encoder emulation

NOTE¹: The isolation of the electronic module is 500 Vac RMS between the electronics power by the TM5 bus and those powered by 24 Vdc I/O power segment connected to the module. In practice, the electronic module is installed in the bus base, and there is a bridge between the TM5 power bus and the 24 Vdc I/O power segment. The two power circuits reference the same functional ground (FE) through specific components designed to reduce effects of electromagnetic interference. These components are rated at 30 Vdc or 60 Vdc. This effectively reduces isolation of the entire system from the 500 Vac RMS.

TM5SE1MISC20005 Wiring Diagram

Wiring Diagram

The following illustration presents the wiring diagram for the TM5SE1MISC20005:



- 1 Internal electronics
- 2 24 Vdc I/O power segment integrated into bus base
- 3 3-wire sensor
- 4 Encoder input

⚠ 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.

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 point¹.
- Route communication and I/O cables separately from power cables.

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

¹Multipoint 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.

 **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.

TM5SE1MISC20005 Output Circuit Diagram

Output Circuit

The output circuit is a symmetrical +5 Vdc, with pull-down resistors on the channels 1-3 and pull-up resistors on the primes of channels 1-3.

Connection Options

Wiring of the incremental encoder output:

Channel	Signal	Meaning
0 (output)	A0	Output state of counter output A
1 (output)	B0	Output state of counter output B
2 (output)	R0	Output state of reference pulse R
3 (input)	DI0	Digital input (24 V asymmetrical)
4 (input)	DI1	Digital input (24 V asymmetrical)



!

%

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.

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.

CANopen

An open industry-standard communication protocol and device profile specification (EN 50325-4).

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.

controller

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

CSA

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

D

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.)

element

The short name of the ARRAY element.

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

function

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

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

H

hot swapping

The replacement of a component with a like component while the system remains under power and operational. The replacement component begins to function automatically after it is installed.

HSC

(*high-speed counter*) A function that counts pulses on the controller or on expansion module inputs.

I**I/O**

(*input/output*)

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 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.

M**machine**

Consists of several *functions* and/or *equipment*.

ms

(*millisecond*)

N**network**

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

P**PCI**

(*peripheral component interconnect*) An industry-standard bus for attaching peripherals.

PDM

(*power distribution module*) A module that distributes either AC or DC field power to a cluster of I/O modules.

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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