

Modicon TM5

Transmitter and Receiver Modules

Hardware Guide

09/2020



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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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Table of Contents



	Safety Information	5
	About the Book	7
Part I	General Overview	11
Chapter 1	TM5 System General Rules for Implementing	13
	Installation and Maintenance Requirements	14
	Wiring Best Practices	16
	TM5 Environmental Characteristics	20
	Installation Guidelines	23
	Hot Swapping Electronic Modules	24
Chapter 2	TM5 Transmitter and Receiver General Overview	27
	General Description	28
	Physical Description	31
Part II	TM5 System Transmitter and Receiver Electronic	
	Modules	35
Chapter 3	TM5SBET1 Transmitter Electronic Module	37
	TM5SBET1 Presentation	38
	TM5SBET1 Characteristics	41
	TM5SBET1 Wiring Diagram	42
Chapter 4	TM5SBET7 Transmitter Electronic Module	43
	TM5SBET7 Presentation	44
	TM5SBET7 Characteristics	46
	TM5SBET7 Wiring Diagram	47
Chapter 5	TM5SBER2 Receiver Electronic Module	49
	TM5SBER2 Presentation	50
	TM5SBER2 Characteristics	53
	TM5SBER2 Wiring Diagram	56
Glossary	57
Index	61

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 Modicon TM5 Transmitter and Receiver modules. It provides parts descriptions, specifications, wiring diagrams, installation and setup for Modicon TM5 Transmitter and Receiver modules.

Validity Note

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

Related Documents

Title of Documentation	Reference Number
Modicon TM5 Expansion Modules Configuration Programming Guide	<u>EIO0000003179 (ENG)</u> <u>EIO0000003180 (FRE)</u> <u>EIO0000003181 (GER)</u> <u>EIO0000003182 (SPA)</u> <u>EIO0000003183 (ITA)</u> <u>EIO0000003184 (CHS)</u>
Modicon TM5 / TM7 Flexible System - System Planning and Installation Guide	<u>EIO0000003161 (ENG)</u> <u>EIO0000003162 (FRE)</u> <u>EIO0000003163 (GER)</u> <u>EIO0000003164 (SPA)</u> <u>EIO0000003165 (ITA)</u> <u>EIO0000003166 (CHS)</u>
Communication Electronic Modules TM5 Transmitter and Receiver Instruction Sheet	<u>S1A12567(ENG)</u>

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

General Overview

What Is in This Part?

This part contains the following chapters:

Chapter	Chapter Name	Page
1	TM5 System General Rules for Implementing	13
2	TM5 Transmitter and Receiver General Overview	27

Chapter 1

TM5 System General Rules for Implementing

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Installation and Maintenance Requirements	14
Wiring Best Practices	16
TM5 Environmental Characteristics	20
Installation Guidelines	23
Hot Swapping Electronic Modules	24

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 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.	$\frac{9}{0.35}$ 				
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:

mm in.	$\frac{9}{0.35}$ 			
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 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.

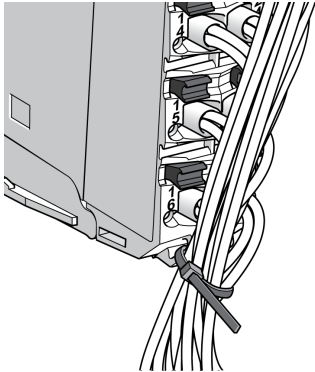
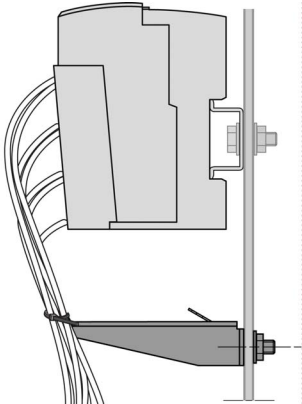
NOTE: To help prevent a terminal block from being inserted incorrectly, ensure that each terminal block and electronic module is clearly and uniquely coded.

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.

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	–	

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.

Characteristic		Minimum Specification	Tested Range
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
<p>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.</p>			

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
<p>Criteria A Uninterrupted operation during test. Criteria B Brief interruption during the test allowed. (1) Applies for TM5SE11C20005 and TM5SE1MISC20005.</p> <p>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.</p>			

Characteristic	Minimum Specification	Tested Range
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)
<p>Criteria A Uninterrupted operation during test. Criteria B Brief interruption during the test allowed. (1) Applies for TM5SE1IC20005 and TM5SE1MISC20005.</p> <p>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.</p>		

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</i> .
Electronic modules installation	Refer to: <ul style="list-style-type: none"> ● <i>TM5 Association Table</i>. ● <i>Expanding the TM5 System</i>.
Accessories installation	Refer to the <i>Installation of Accessories</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 26*).

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.

Chapter 2

TM5 Transmitter and Receiver General Overview

Overview

This chapter is an overview of the TM5 transmitter and receiver electronic modules.

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
General Description	28
Physical Description	31

General Description

Overview

The TM5 System provides a virtual rack system through a decentralized backplane. The decentralized backplane contains a local configuration and several remote configurations connected together using specific expansion bus cables. The TM5 Transmitter and Receiver electronic modules handle the communication between remote electronic modules via expansion bus cables.

The TM5 Transmitter and Receiver electronic modules need to be associated with a bus base and a terminal block.

Remote Island Features

The following table gives information about the TM5 Transmitter and Receiver used in the TM5 System:

Reference	Description
TM5SBET1 <i>(see page 38)</i>	Transmits the TM5 data bus.
TM5SBET7 <i>(see page 43)</i>	Transmits the TM7 data bus and provides the TM7 power bus to the TM7 expansion I/O blocks.
TM5SBER2 <i>(see page 50)</i>	Receives the TM5 data bus, provides power to the 24 Vdc I/O power segment and provides the TM5 power bus to the TM5 expansion I/O blocks.
TCSXCNNXN100	Expansion bus cable.

Cable Characteristics

The TM5 cable used between Transmitter and Receiver modules is the TCSXCNNXNX100 cable, measuring approximately 100 m (328.1 ft). The cable contains two sets of twisted shielded pairs to limit the electromagnetic interference from the power wires to the DATA signal wires. Both pairs are shielded with a common tinned copper foil with an additional drain wire.

The following table describes the characteristics of the individual wire pairs of the cable:

Wire	Characteristic	Value
Pair A	Conductor cross section (gauge)	0.34 mm ² (22 AWG)
	Linear resistance	55 Ω/km
Pair B	Conductor cross section (gauge)	0.2 mm ² (24 AWG)
	Linear resistance	90 Ω/km
	Characteristic impedance	120 Ω

The following table lists the description of the individual wire pairs of the cable:

Wire	Description	Color
Pair A	TM5 Power Bus + 5 Vdc (used only for TM5 IP20 towards TM7 IP67)	Red
	TM5 Power Bus 0 Vdc (TM5 bus ref.)	Black
Pair B	TM5 DATA high	White
	TM5 DATA low	Blue

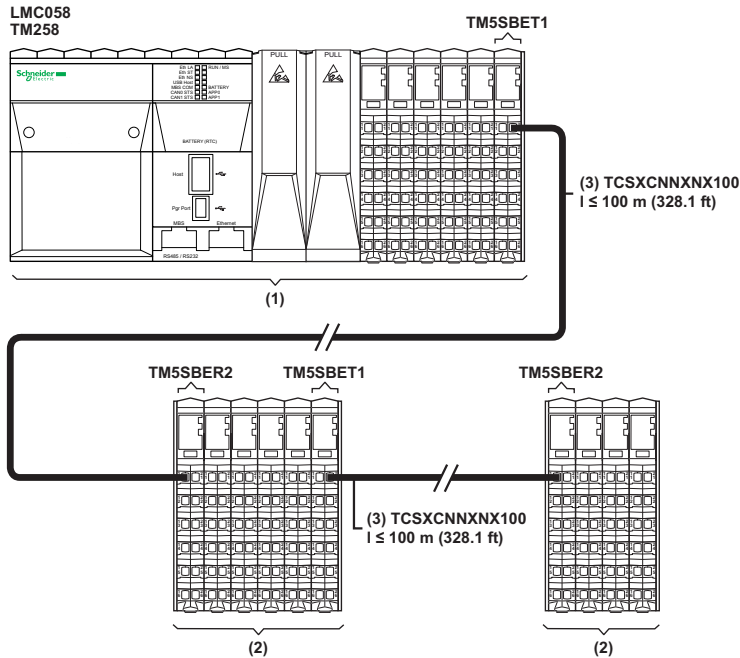
The following table lists the general characteristics of the cable:

Characteristic	Description
Shield	Tinned copper foil and drain wire
Sheath color	grey
Operating temperature	-10 ... +80 °C (14 ... 176 °F)
Storage temperature	-25 ... +80 °C (-13 ... 176 °F)
Overall diameter	7.4 mm (0.29 in.) ± 0.2 mm (0.007 in.)
Minimum curve radius - fixed applications	67 mm (2.63 in.)
Fire retardant	IEC 60332-1
Low smoke	VDE 0207-24
Zero halogen	EN50290-2-27

Implementation of TM5 Transmitter and Receiver Electronic Modules

The maximum distance between a Transmitter and a Receiver is 100 m (328.1 ft). The maximum overall distance between the beginning of the local configuration containing a Transmitter and the end of the last remote configuration containing a Receiver is 2500 m (8202.1 ft). The TM5 twisted-pair cable (TCSXCNNXNX100) is required to obtain the maximum distance, the proper electromagnetic resistance and performance required for the communication between Transmitter and Receiver. In addition, the cable must be properly grounded to the functional ground (FE) of your TM5 System.

The following picture presents the TM5 System divided into a local configuration and remote configuration:



- (1) Local Configuration
- (2) Remote I/O Island Configurations
- (3) Expansion bus cable TCSXCNNXNX100

NOTE: For more information to configure Transmitter and Receiver electronic modules refer to *Modicon TM5 Expansion Modules Configuration Programming Guide*.

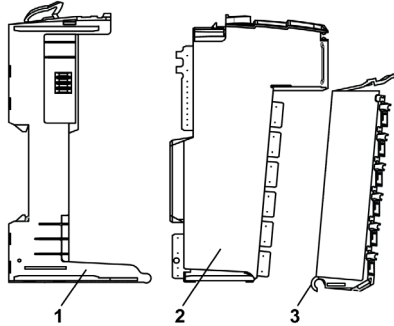
Physical Description

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

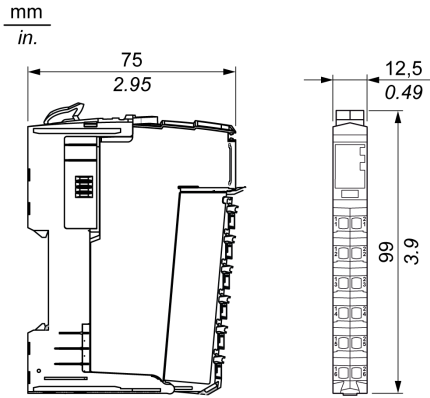
ELECTROSTATIC DISCHARGE

- 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.

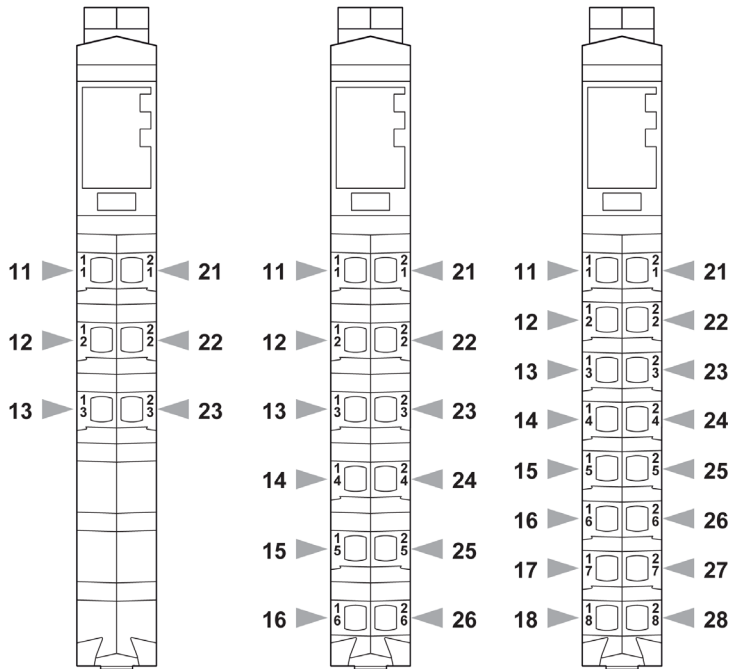
Dimensions

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*.

Labeling

Refer to the *Labeling the TM5 System*.

Part II

TM5 System Transmitter and Receiver Electronic Modules

What Is in This Part?

This part contains the following chapters:

Chapter	Chapter Name	Page
3	TM5SBET1 Transmitter Electronic Module	37
4	TM5SBET7 Transmitter Electronic Module	43
5	TM5SBER2 Receiver Electronic Module	49

Chapter 3

TM5SBET1 Transmitter Electronic Module

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
TM5SBET1 Presentation	38
TM5SBET1 Characteristics	41
TM5SBET1 Wiring Diagram	42

TM5SBET1 Presentation

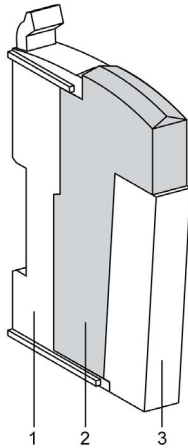
Main Characteristics

The table below describes the main characteristics of the TM5SBET1 electronic module:

Main Characteristics	
Function	Transmits the TM5 data bus.
Maximum bus length	2500 m (8202.1 ft)
Maximum cable distance between Transmitter and Receiver	100 m (328.1 ft)
Power distribution	No

Ordering Information

The following figure and table give the references to create a slice with the TM5SBET1 electronic module:



NOTICE

ELECTROSTATIC DISCHARGE

- Install a right bus base locking plate to the rightmost slice of all configurations.
- Install a left bus base locking plate to the first slice of all remote configurations.

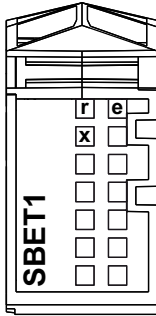
Failure to follow these instructions can result in equipment damage.

Number	Model Number	Description	Color
1	TM5ACBM11	Bus base	White
	or TM5ACBM15	Bus base with address setting	White
2	TM5SBET1	Electronic module	White
3	TM5ACTB06	Terminal block, 6 pins	White
	or TM5ACTB12	Terminal block, 12 pins	White

NOTE: For more information, refer to *TM5 bus bases and terminal blocks*.

Status LEDs

The following figure shows the status LEDs for TM5SBET1:



The table describes the TM5SBET1 status LEDs:

LED	Color	Status	Description
r	Green	Off	No power supply
		Single flash	Reset state
		Flashing	Preoperational state
		On	Normal state
e	Red	Off	OK or no power supply
		Double flash	Indicates one of the following conditions: <ul style="list-style-type: none"> ● Voltage from the 24 Vdc I/O power segment is too low ● Voltage for the TM5 power bus is too low

LED	Color	Status	Description
e+r	Steady red / single green flash		Invalid firmware
X	Yellow	Off	No communication on the TM5 data bus
		On	TM5 data bus communication in progress

TM5SBET1 Characteristics

Introduction

The TM5SBET1 is a data transmitter electronic module. Refer to the environmental specifications (*see page 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.

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

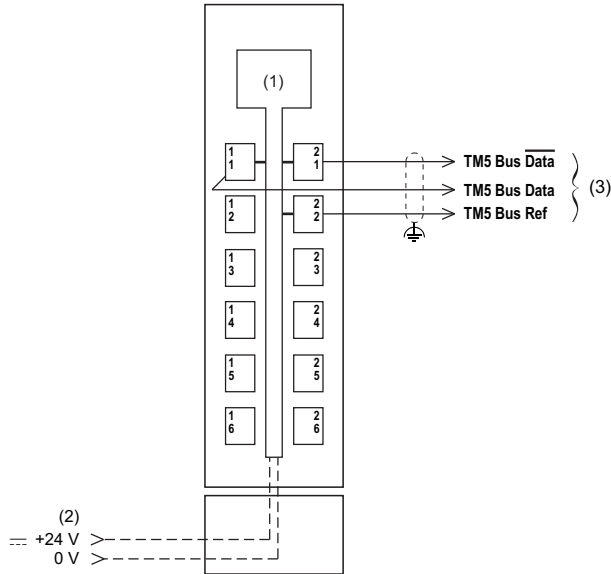
The table below describes the general characteristics of the TM5SBET1 electronic module:

General Characteristics	
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
24 Vdc I/O segment current draw	25 mA
TM5 power bus current draw	100 mA
Power dissipation	1.10 W max.
Weight	25 g (0.9 oz)
ID code for firmware update	7106 dec

TM5SBET1 Wiring Diagram

Wiring Diagram

The following figure shows the wiring diagram for the TM5SBET1:



- (1) Internal electronics
- (2) 24 Vdc I/O power segment integrated into the bus bases
- (3) TM5 expansion bus cable (TCSXCNNXNX100)

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Properly ground the cable shields as indicated in the related documentation.

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.

Chapter 4

TM5SBET7 Transmitter Electronic Module

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
TM5SBET7 Presentation	44
TM5SBET7 Characteristics	46
TM5SBET7 Wiring Diagram	47

TM5SBET7 Presentation

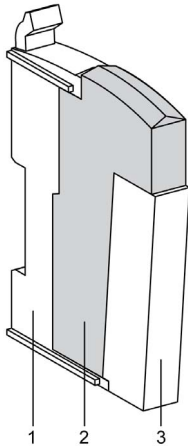
Main Characteristics

The table below describes the main characteristics of the TM5SBET7 electronic module:

Main Characteristics	
Function	Transmits the TM7 data bus and provides the TM7 power bus to the TM7 expansion I/O blocks.
Maximum bus length	2500 m (8202.1 ft)
Maximum cable distance between Transmitter and Receiver	100 m (328 ft)
Power distribution	TM7 power bus

Ordering Information

The following figure and table give the references to create a slice with the TM5SBET7 electronic module:



NOTICE

ELECTROSTATIC DISCHARGE

- Install a right bus base locking plate to the rightmost slice of all configurations.
- Install a left bus base locking plate to the first slice of all remote configurations.

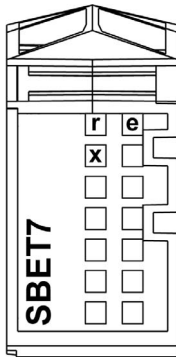
Failure to follow these instructions can result in equipment damage.

Number	Model Number	Description	Color
1	TM5ACBM11	Bus base	White
	or TM5ACBM15	Bus base with address setting	White
2	TM5SBET7	Electronic module	White
3	TM5ACTB12	Terminal block, 12 pins	White

NOTE: For more information, refer to *TM5 bus bases and terminal blocks*.

Status LEDs

The following figure shows the status LEDs for TM5SBET7:



The table describes the TM5SBET7 status LEDs:

LED	Color	Status	Description
r	Green	Off	No power supply
		Single flash	Reset state
		Flashing	Preoperational state
		On	Operational state
e	Red	Off	OK or no power supply
		Double flash	Indicates one of the following conditions: <ul style="list-style-type: none"> ● Voltage from the 24 Vdc I/O power segment is too low ● Voltage for the TM7 power bus is too low
e+r	Steady red / single green flash		Invalid firmware
X	Yellow	Off	No communication on the TM7 data bus
		On	TM7 data bus communication in progress

TM5SBET7 Characteristics

Introduction

The TM5SBET7 is a data transmitter electronic module. Refer to the environmental specifications (*see page 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.

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

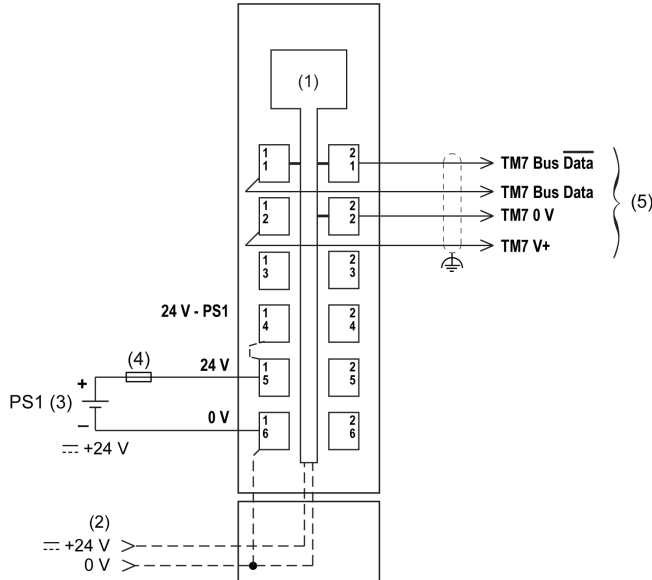
The table below describes the general characteristics of the TM5SBET7 electronic module:

General Characteristics	
Rated power supply voltage	24 Vdc
Power supply range	20.4...28.8 Vdc
24 Vdc I/O segment current draw	25 mA
TM5 power bus current draw	100 mA
Power dissipation	1.10 W max.
Weight	25 g (0.9 oz)
ID code for firmware update	41528 dec

TM5SBET7 Wiring Diagram

Wiring Diagram

The following figure shows the wiring diagram for the TM5SBET7:



- (1) Internal electronics
- (2) 24 Vdc I/O power segment integrated into the bus bases
- (3) PS1/PS2: External isolated power supply 24 Vdc
- (4) External fuse, Type T slow-blow: 1 A max., 250 V
- (5) TM7 Expansion bus cable (TCSXCN•FNX••E)

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Properly ground the cable shields as indicated in the related documentation.

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.

Chapter 5

TM5SBER2 Receiver Electronic Module

What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
TM5SBER2 Presentation	50
TM5SBER2 Characteristics	53
TM5SBER2 Wiring Diagram	56

TM5SBER2 Presentation

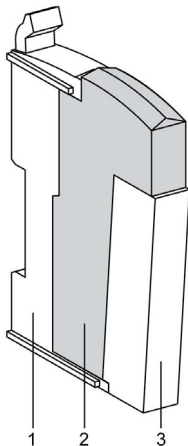
Main Characteristics

The table below describes the main characteristics of the TM5SBER2 electronic module:

Main Characteristics	
Function	Receives the TM5 data bus
Maximum bus length	2500 m (8202.1 ft)
Maximum cable distance between Transmitter and Receiver	100 m (328.1 ft)
Power distribution	<ul style="list-style-type: none"> ● TM5 power bus ● 24 Vdc I/O power segment

Ordering Information

The following figure and table give the references to create a slice with the TM5SBER2 electronic module:



NOTICE

ELECTROSTATIC DISCHARGE

- Install a right bus base locking plate to the rightmost slice of all configurations.
- Install a left bus base locking plate to the first slice of all remote configurations.

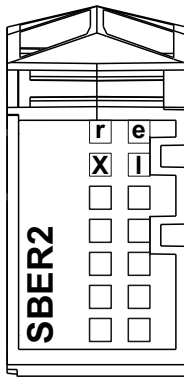
Failure to follow these instructions can result in equipment damage.

Number	Model Number	Description	Color
1	TM5ACBM01R or TM5ACBM05R	Bus base Bus base with address setting	Gray Gray
2	TM5SBER2	Electronic module	Gray
3	TM5ACTB12PS	Terminal block, 12-pins	Gray

NOTE: For more information, refer to *TM5 bus bases and terminal blocks*.

Status LEDs

The following figure shows the status LEDs for TM5SBER2:



The table below describes the TM5SBER2 status LEDs:

LED	Color	Status	Description
r	Green	Off	No power supply
		Single Flash	Reset state
		Flashing	Preoperational state
		On	Run state
e	Red	Off	OK or no power supply
		Double flash	Indicates one of the following conditions: <ul style="list-style-type: none"> ● TM5 power bus current is too high (overload) ● Voltage for the 24 Vdc I/O power segment is too low ● Voltage for the TM5 power bus is too low
e+r	Steady red / single green flash		Invalid firmware

LED	Color	Status	Description
X	Yellow	Off	No communication on the TM5 data bus
		On	TM5 data bus communication in progress
I	Red	Off	TM5 power bus in the acceptable range
		On	TM5 power bus current is too high (overload)

TM5SBER2 Characteristics

Introduction

The TM5SBER2 is a data receiver electronic module. Refer also to the environmental characteristics (*see page 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.

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 table below describes the general characteristics of the TM5SBER2 electronic module:

General Characteristics	
Rated power supply voltage	24 Vdc
24 Vdc I/O segment current draw	25 mA
Power dissipation	2.22 W max.
Weight	25 g (0.9 oz)
ID code for firmware update	7105 dec

TM5 Power Bus Characteristics

The following table shows the TM5 power bus characteristics of the TM5SBER2 electronic module:

TM5 power bus characteristics	
Power supply range	20.4...28.8 Vdc
Rated input current	0.7 A max. at 24 Vdc
Reverse polarity protection	Yes
Fuse	Integrated, can not be exchanged
Current generated	1156 mA
De-rating	- 10...55 °C (14...131 °F): 1156 mA
	55...60 °C (131...140 °F): 756 mA
Parallel operation	Yes ²
Electrical isolation	See note ¹
<p>1 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 or 60 V.</p> <p>2 In parallel operation, only 75% of the rated power can be assumed. Please ensure that all parallel operating power supplies are switched on and off simultaneously.</p>	

Do not mount a Power Distribution Module (PDM) side-by-side with a Receiver module.

⚠ WARNING
<p>UNINTENDED EQUIPMENT OPERATION</p> <p>Do not mount a Power Distribution Module (PDM) next to any one of the following modules:</p> <ul style="list-style-type: none"> ● Power Distribution Module (PDM) ● Transmitter module TM5SBET1 or TM5SBET7 ● Receiver module TM5SBER2 ● Interface Power Distribution Module TM5SPS3 (IPDM) ● Analog input module TM5SAI2H or TM5SAI4H ● Analog output module TM5SAO4L or TM5SAO4H <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p>

24 Vdc I/O Power Segment Characteristics

The following table shows the 24 Vdc I/O power segment characteristics of the TM5SBER2 electronic module:

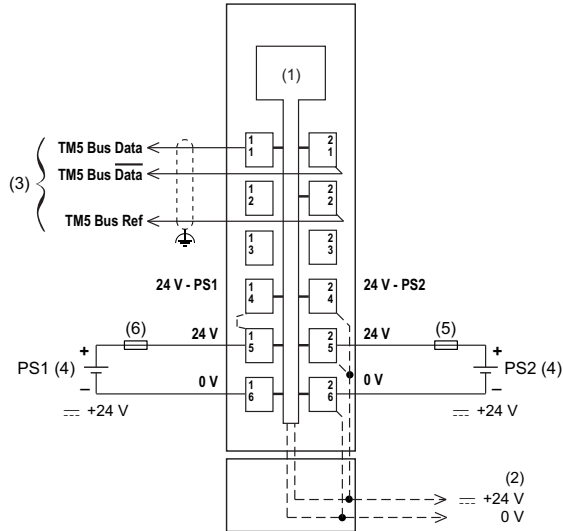
24 Vdc I/O power segment characteristics	
Power supply range	20.4...28.8 Vdc
Rated power supply voltage	24 Vdc
Maximum current provided	10 A
Reverse polarity protection	No
Short circuit protection	External fuse type T slow-blow 10 A 250 V
Isolation between power segment and TM5 power and data buses	See note ¹

¹ The isolation of the electronic module is 500 Vac RMS between the electronics powered by the TM5 bus and those powered by 24 Vdc I/O power segment connected to the module. In practice, the TM5 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.

TM5SBER2 Wiring Diagram

Wiring Diagram

The following figure shows the wiring diagram for the TM5SBER2:



- (1) Internal electronics
- (2) 24 Vdc I/O power segment integrated into the bus bases
- (3) TM5 expansion bus cable (TCSXCNNXNX100)
- (4) PS1/PS2: External isolated power supply 24 Vdc
- (5) External fuse, Type T slow-blow: 10 A max., 250 V
- (6) External fuse, Type T slow-blow: 1 A, 250 V

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Properly ground the cable shields as indicated in the related documentation.

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.



!

%

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.

B

bus base

A mounting device that is designed to seat an electronic module on a DIN rail and connect it to the TM5 bus for M258 and LMC058 logic controllers. Each base bus extends the integrated TM5 data and electronic power buses as well as the 24 Vdc I/O power segment. The electronic modules are added to the TM5 system through their insertion on the base bus.

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).

configuration

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

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

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.

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.

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 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.

L

LED

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

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.



E

Electronic modules

documentation references, *23*

installation, *23*

environmental characteristics, *20*

H

hot swapping, *24*

I

installation and Maintenance

installation and Maintenance requirements, *14*

T

Technical Data

TM5SBER2, *53*

TM5SBET1, *41*

TM5SBET7, *46*

TM5 receiver

TM5SBER2, *49*

TM5 transmitter

TM5SBET1, *37*

TM5SBET7, *43*

TM5SBER2, *49*

TM5SBET1, *37*

TM5SBET7, *43*

W

wiring rules, *16*

