

# Modicon TM5

## Transmitter and Receiver Modules Hardware Guide

04/2012



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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.

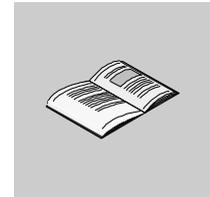
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Failure to observe this information can result in injury or equipment damage.

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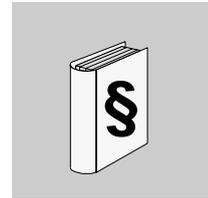


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## Safety Information



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### Important Information

#### NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



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



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

### **DANGER**

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

### **WARNING**

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

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 **CAUTION**

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

***NOTICE***

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

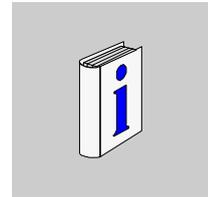
**PLEASE NOTE**

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

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

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## About the Book



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### 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 with the release of SoMachine V3.1.

#### 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)
IF Communication Electronic Modules TM5 Transmitter and Receiver Instruction Sheet	S1A12567 00

You can download these technical publications and other technical information from our website at [www.schneider-electric.com](http://www.schneider-electric.com).

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## 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**

#### **EXPLOSIVE POTENTIAL**

- 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.

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

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## **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.<sup>1</sup>
- 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.**

<sup>1</sup> 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.**

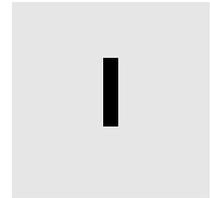
### **User Comments**

We welcome your comments about this document. You can reach us by e-mail at [techcomm@schneider-electric.com](mailto:techcomm@schneider-electric.com).



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# General Overview



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## What's in this Part?

This part contains the following chapters:

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# TM5 System General Rules for Implementing



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## What's in this Chapter?

This chapter contains the following topics:

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## Installation Requirements

### Before Starting

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

### **DANGER**

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**

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

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

### **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.**

### Programming Considerations

### **WARNING**

#### **UNINTENDED EQUIPMENT OPERATION**

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

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

**Operating Environment**

** DANGER**

**EXPLOSIVE POTENTIAL**

- 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.

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

** WARNING**

**UNINTENDED EQUIPMENT OPERATION**

Install and operate this equipment according to the environmental conditions described in the operating limits.

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

## Installation Considerations

### **WARNING**

#### **UNINTENDED EQUIPMENT OPERATION**

- Use appropriate safety interlocks where personnel and/or equipment hazards exist.
- Install and operate this equipment in an enclosure appropriately rated for its intended environment.
- Use the sensor and actuator power supplies only for supplying power to the sensors or actuators connected to the module.
- Power line and output circuits must be wired and fused in compliance with local and national regulatory requirements for the rated current and voltage of the particular equipment.
- Do not use this equipment in safety-critical machine functions.
- Do not disassemble, repair, or modify this equipment.
- Do not connect any wiring to reserved, unused connections, or to connections designated as Not Connected (N.C.).

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

**NOTE:** Schneider Electric recommends the use of UL-recognized and CSA approved JDYX2 or JDYX8 fuse types.

## Wiring Rules and Recommendations

### 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 field bus (CAN, serial, Ethernet).

## ⚠ WARNING

### IMPROPER GROUNDING CAN CAUSE UNINTENDED EQUIPMENT OPERATION

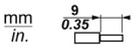
- Use cables with insulated shielded jackets for analog I/O, fast I/O and communication signals.
- Ground shielded cables for analog I/O, fast I/O and communication signals at a single point <sup>1</sup>
- Always comply with local wiring requirements regarding grounding of cable shields.

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

**NOTE:** <sup>1</sup>Multipoint grounding is permissible if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short circuit currents.

Refer to the section Grounding the TM5 System (*see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide*) to ground the shielded cables.

The table below provides the wire sizes to use with the removable spring terminal blocks:

 mm in.				
mm <sup>2</sup>	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

## ⚠ DANGER

### FIRE HAZARD

Use only the recommended wire sizes for 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 terminal block without a double wire cable end.

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

**Terminal Block**

Plugging a terminal block into the incorrect electronic module can cause an electric shock or unintended operation of the application and/or damage the electronic module.

**⚠ DANGER****UNINTENDED EQUIPMENT OPERATION OR ELECTRIC SHOCK**

Be sure to connect the terminal blocks to their designated location.

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

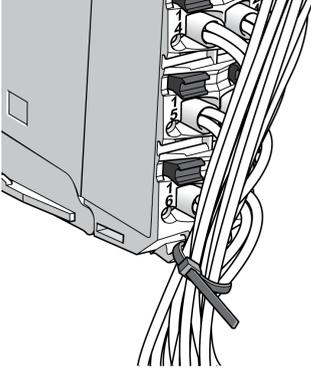
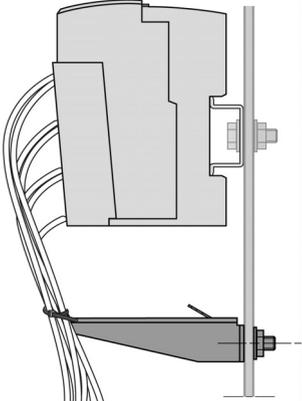
**NOTE:** To help prevent a terminal block from being inserted incorrectly, clearly and uniquely code and label each terminal block and electronic module according to the instructions in *Coding the TM5 System (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)*.

**Stress Relief Using Cable Tie**

There are two methods to reduce the stress on cables:

- The terminal blocks (*see Modicon 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 via the TM2XMTGB grounding plate (*see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide*), wires can be bundled and fixed to the grounding plate tabs using wire ties to reduce stress on the cables.

The table below provides the size of the cable tie and shows 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 figure		

## **Environmental Characteristics**

### **Introduction**

The following information describes the system-wide environmental requirements and characteristics for the TM5 System.

The general environmental characteristics are common to all components of the TM5 System.

### **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.

All 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. Your enclosure should be constructed of metal to improve the electromagnetic immunity of your TM5 System. Your enclosure should have a keyed locking mechanism to minimize unauthorized access.

## Environmental Characteristics

This equipment meets UL, CSA, GOST-R and c-Tick certifications and CE requirements as indicated in the table below. This equipment is intended for use in a Pollution Degree 2 industrial environment.

The table below provides the general environmental characteristics:

Characteristic	Specification	
This product is compliant with Europe RoHS recommendations and China RoHS regulations. 		
Standard	IEC61131-2 ed. 3 2007	
Agencies	UL 508 CSA 22.2 No. 142-M1987 CSA 22.2 No. 213-M1987	
Ambient operating temperature	Horizontal installation	-10...60 °C (14...140 °F) <sup>1, 2</sup>
	Vertical installation	-10...50 °C (14...122 °F) <sup>2</sup>
Storage temperature	-40...70 °C (-40...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 <sup>2</sup> (1 g <sub>n</sub> ) fixed acceleration from 8.4...150 Hz
Mechanical shock resistance	147 m/s <sup>2</sup> (15 g <sub>n</sub> ) for a duration of 11 ms	
Connection type	Removable spring terminal block	
Connector insertion/removal cycles	50	
<p>Note:</p> <p><b>1</b> Some devices have temperature operating restrictions that require de-rating between 55 °C and 60 °C (131 °F and 140 °F), and may be subject to other possible restrictions. See the specific characteristics for your electronic module.</p> <p><b>2</b> For compliance to Class I, Div 2 environment ratings, do not operate this device in locations with ambient temperatures less than 0 °C (32° F).</p>		

## 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) 1 V/m (2...2.7 GHz)
Fast transients burst	IEC/EN 61000-4-4	Power lines: 2 kV I/O: 1 kV Shielded cable: 1 kV Repetition rate: 5 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 <sub>eff</sub> (0.15...80 MHz)
Conducted emission	EN 55011 (IEC/CISPR11)	150...500 kHz, quasi peak 79 dB $\mu$ V
		500 kHz...30 MHz, quasi peak 73 dB $\mu$ V
Radiated emission	EN 55011 (IEC/CISPR11)	30...230 MHz, 10 m@40 dB $\mu$ V/m
		230 MHz...1 GHz, 10 m@47 dB $\mu$ V/m

## Installation Guidelines

### Installation

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

<b>Spacing requirement</b>	<p>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>.</p> <p><b>NOTE:</b> The TM5 System is designed to operate between - 10°C (14°F) and 55°C (131°F) without derating and up to 60°C (140°F) with some special rules and some derating on some products.</p>
<b>Electronic modules installation</b>	<p>Refer to:</p> <ul style="list-style-type: none"> <li>● <i>TM5 Association Table (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)</i>.</li> <li>● <i>Expanding the TM5 System (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)</i>.</li> </ul>
<b>Accessories installation</b>	<p>Refer to the <i>Installation of Accessories (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)</i>.</p>

## 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 27*).

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 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 consequences 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.<sup>1</sup>
- 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.**

<sup>1</sup> 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 consequences 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:

<b>TM5</b>	<b>Electronic Modules Type</b>	<b>Reasons</b>
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 documentations associated to the CANopen master.
Compact I/O	I/O modules	These modules are not removable.



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# TM5 Transmitter and Receiver General Overview

# 2

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## Overview

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

## What's in this Chapter?

This chapter contains the following topics:

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General Description	30
Physical Description	33

## 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 40)</i>	Transmits the TM5 data bus.
TM5SBET7 <i>(see page 45)</i>	Transmits the TM7 data bus and provides the TM7 power bus to the TM7 expansion I/O blocks.
TM5SBER2 <i>(see page 52)</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.
TCSXCNNXNX100	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 <sup>2</sup> (22 AWG)
	Linear resistance	55 Ω/km
Pair B	Conductor cross section (gauge)	0.2 mm <sup>2</sup> (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

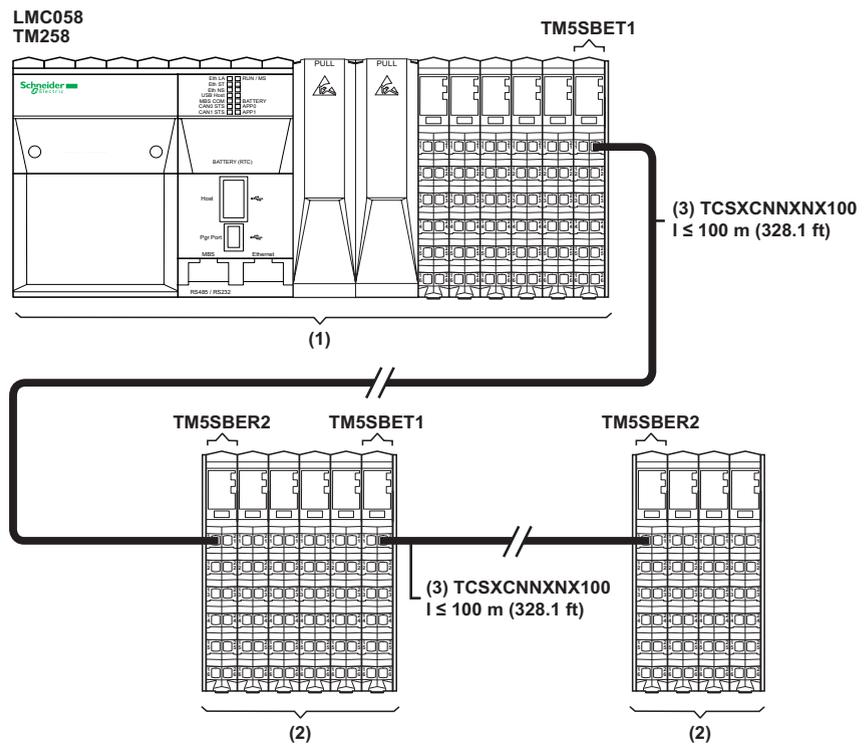
The following table lists the general characteristics of the cable:

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 (see page 17).

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*.

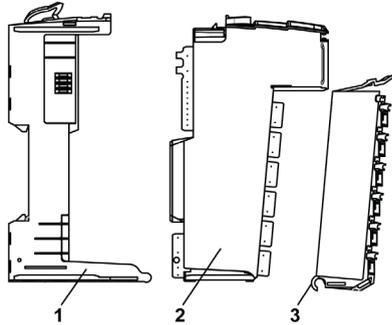
## Physical Description

### Introduction

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

### Elements

The following figure 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***

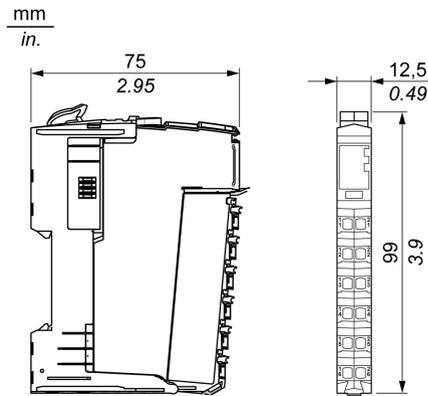
### **ELECTROSTATIC DISCHARGE**

- 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.**

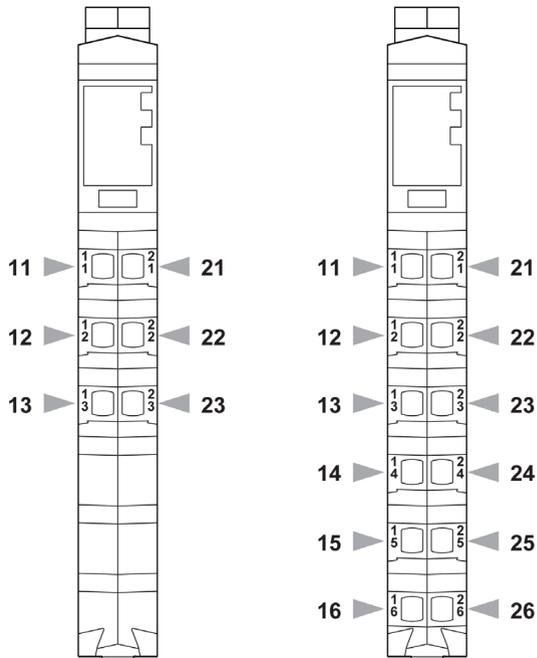
## Dimensions

The following figure shows the dimensions of a slice:



## Pin Assignment

The following figure shows the pin assignments respectively for the 6-pin and the 12-pin terminal blocks:



## **Accessories**

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

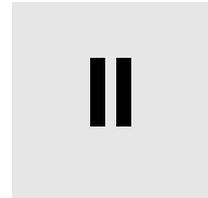
## **Labeling**

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



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# TM5 System Transmitter and Receiver Electronic Modules



---

## What's in this Part?

This part contains the following chapters:

Chapter	Chapter Name	Page
3	TM5SBET1 Transmitter Electronic Module	39
4	TM5SBET7 Transmitter Electronic Module	45
5	TM5SBER2 Receiver Electronic Module	51



---

# TM5SBET1 Transmitter Electronic Module

# 3

---

## What's in this Chapter?

This chapter contains the following topics:

Topic	Page
TM5SBET1 Presentation	40
TM5SBET1 Characteristics	42
TM5SBET1 Wiring Diagram	43

## TM5SBET1 Presentation

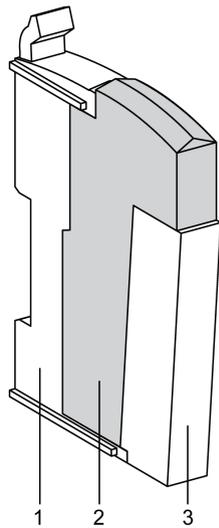
### Main Characteristics

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

<b>Main Characteristics</b>	
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.

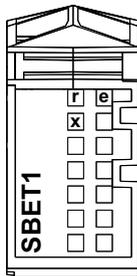
**Failure to follow these instructions can result in equipment damage.**

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* (see *Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide*).

### 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"> <li>● Voltage from the 24 Vdc I/O power segment is too low</li> <li>● Voltage for the TM5 power bus is too low</li> </ul>
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 21*).

 <b>DANGER</b>
<p><b>FIRE HAZARD</b></p> <p>Use only the recommended wire sizes for I/O channels and power supplies.</p> <p><b>Failure to follow these instructions will result in death or serious injury.</b></p>

 <b>WARNING</b>
<p><b>UNINTENDED EQUIPMENT OPERATION</b></p> <p>Do not exceed any of the rated values specified in the following tables.</p> <p><b>Failure to follow these instructions can result in death, serious injury, or equipment damage.</b></p>

### General Characteristics

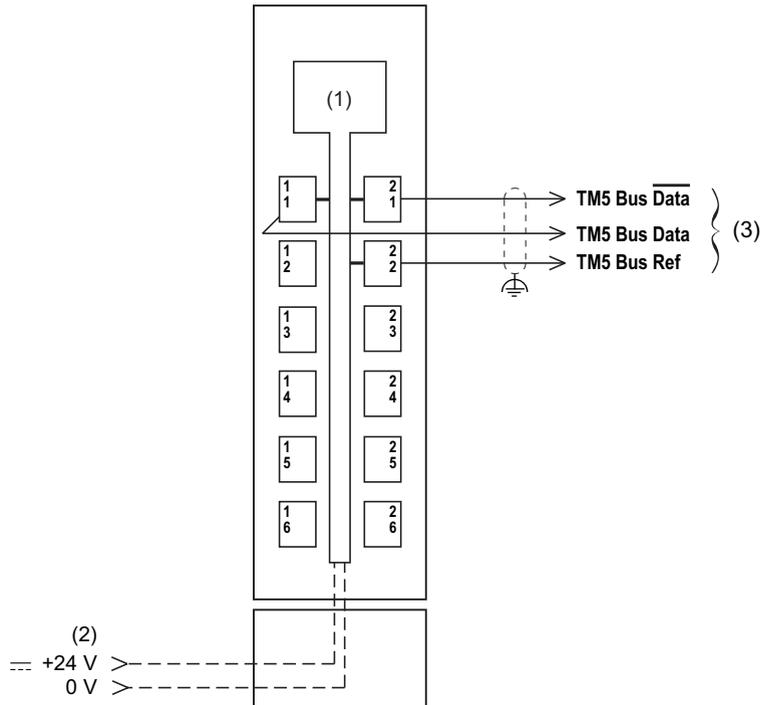
The table below describes the general characteristics of the TM5SBET1 electronic module:

<b>General Characteristics</b>	
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 or terminals marked “Not Connected (N.C.)”.

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

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# TM5SBET7 Transmitter Electronic Module

# 4

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## What's in this Chapter?

This chapter contains the following topics:

Topic	Page
TM5SBET7 Presentation	46
TM5SBET7 Characteristics	48
TM5SBET7 Wiring Diagram	49

## TM5SBET7 Presentation

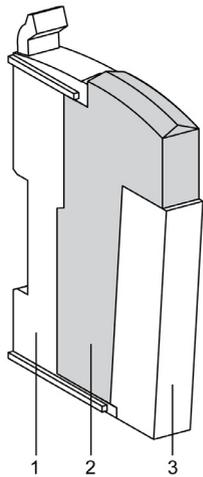
### Main Characteristics

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

<b>Main Characteristics</b>	
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.

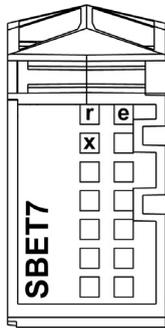
**Failure to follow these instructions can result in equipment damage.**

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* (see *Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide*).

### 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"> <li>● Voltage from the 24 Vdc I/O power segment is too low</li> <li>● Voltage for the TM7 power bus is too low</li> </ul>
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 21*).

**⚠ DANGER**

**FIRE HAZARD**

Use only the recommended wire sizes for 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 following tables.

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

### General Characteristics

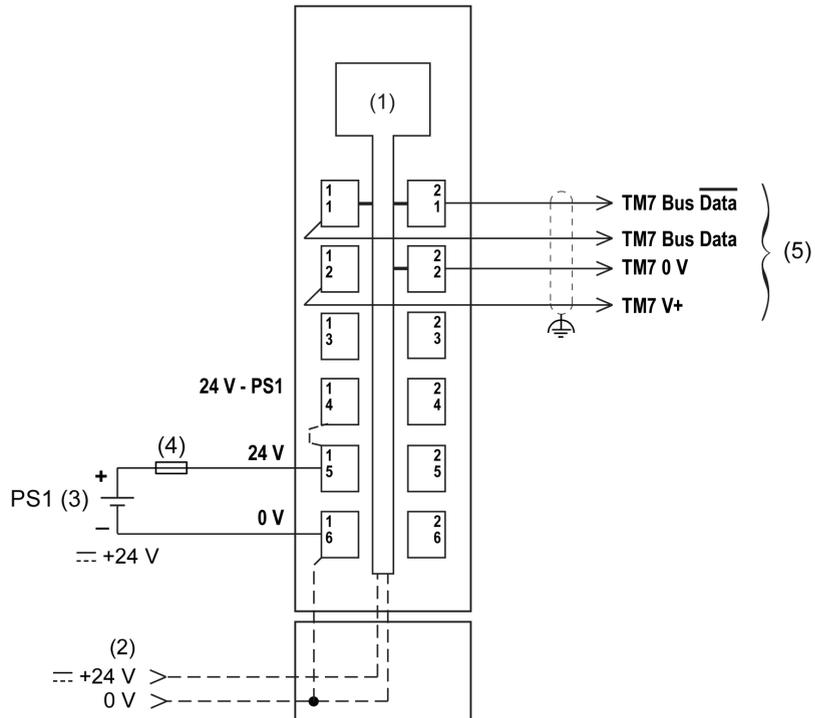
The table below describes the general characteristics of the TM5SBET7 electronic module:

<b>General Characteristics</b>	
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 or terminals marked “Not Connected (N.C.)”.

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

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# TM5SBER2 Receiver Electronic Module



# 5

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## What's in this Chapter?

This chapter contains the following topics:

Topic	Page
TM5SBER2 Presentation	52
TM5SBER2 Characteristics	54
TM5SBER2 Wiring Diagram	57

## TM5SBER2 Presentation

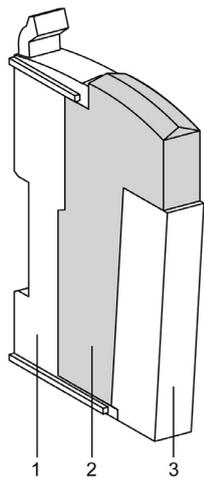
### Main Characteristics

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

<b>Main Characteristics</b>	
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"> <li>● TM5 power bus</li> <li>● 24 Vdc I/O power segment</li> </ul>

### 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.

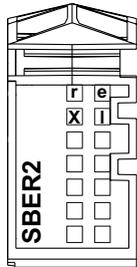
**Failure to follow these instructions can result in equipment damage.**

Number	Model Number	Description	Color
1	TM5ACBM01R	Bus base	Gray
	or TM5ACBM05R	Bus base with address setting	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 (see Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide)*.

### 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"> <li>● TM5 power bus current is too high (overload)</li> <li>● Voltage for the 24 Vdc I/O power segment is too low</li> <li>● Voltage for the TM5 power bus is too low</li> </ul>
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
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 21*).

### DANGER

#### **FIRE HAZARD**

Use only the recommended wire sizes for 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 following 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:

<b>General Characteristics</b>	
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:

<b>TM5 power bus characteristics</b>	
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 <sup>2</sup>
Electrical isolation	See note <sup>1</sup>
<p><b>1</b> 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><b>2</b> 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.

 <b>WARNING</b>
<p><b>UNINTENDED EQUIPMENT OPERATION</b></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"> <li>● Power Distribution Module (PDM)</li> <li>● Transmitter module TM5SBET1 or TM5SBET7</li> <li>● Receiver module TM5SBER2</li> <li>● Interface Power Distribution Module TM5SPS3 (IPDM)</li> <li>● Analog input module TM5SAI2H or TM5SAI4H</li> <li>● Analog output module TM5SAO4L or TM5SAO4H</li> </ul> <p><b>Failure to follow these instructions can result in death, serious injury, or equipment damage.</b></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:

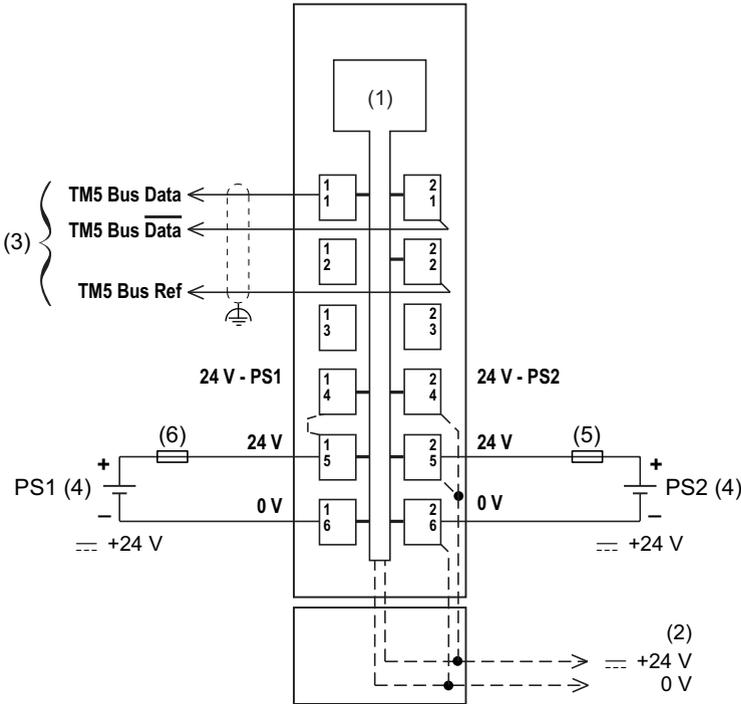
<b>24 Vdc I/O power segment characteristics</b>	
Power supply range	20.4...28.8 Vdc
Rated power supply voltage	24 Vdc
Maximum current provided	10 A
Reverse polarity protection	No
Short circuit protection	External fuse type T slow-blow 10 A 250 V
Isolation between power segment and TM5 power and data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

<sup>1</sup> 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 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

<b>⚠ WARNING</b>
<b>UNINTENDED EQUIPMENT OPERATION</b>
Properly ground the cable shields as indicated in the related documentation.
<b>Failure to follow these instructions can result in death, serious injury, or equipment damage.</b>

 **WARNING**

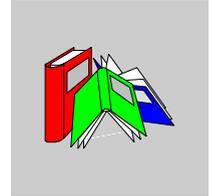
**UNINTENDED EQUIPMENT OPERATION**

Do not connect wires to unused terminals or terminals marked “Not Connected (N.C.)”.

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

---

# Glossary



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## A

### analog input

An *analog input* module contains circuits that convert an analog DC input signal to a digital value that can be manipulated by the processor. By implication, the analog input is usually direct. That means a data table value directly reflects the analog signal value.

### analog output

An *analog output* module contains circuits that transmit an analog DC signal proportional to a digital value input to the module from the processor. By implication, these analog outputs are usually direct. That means a data table value directly controls the analog signal value.

### AWG

The *american wire gauge* standard specifies wire gauges in North America.

## B

### bus base

A *bus base* is 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 controllers. Each base bus extends the TM5 data and to the power buses and the 24 Vdc I/O power segment. The electronic modules are added to the TM5 system through their insertion on the base bus. The base bus also supplies the articulation point for the terminal blocks.

## C

### **CAN**

The *controller area network* protocol (ISO 11898) for serial bus networks is designed for the interconnection of smart devices (from multiple manufacturers) in smart systems for real-time industrial applications. CAN multimaster systems help ensure high data integrity through the implementation of broadcast messaging and advanced diagnostic mechanisms. Originally developed for use in automobiles, CAN is now used in a variety of industrial automation control environments.

### **CANopen**

CANopen is an open industry-standard communication protocol and device profile specification.

### **compact I/O module**

A *compact I/O module* is an indissociable group of five analog and/or digital I/O electronic modules in a single reference.

### **configuration**

The *configuration* includes the arrangement and interconnection of hardware components within a system and the hardware and software selections that determine the operating characteristics of the system.

### **controller**

A *controller* (or “programmable logic controller,” or “programmable controller”) is used to automate industrial processes.

### **CPDM**

*controller power distribution module*

### **CSA**

The *canadian standards association* defines and maintains standards for industrial electronic equipment in hazardous environments.

### **CTS**

*Clear to send* is a data transmission signal and acknowledges the RDS signal from the transmitting station.

## D

### De-rating

*De-rating* describes a reduction in an operating specification. For devices in general it is usually a specified reduction in nominal power to facilitate operation at increased ambient conditions like higher temperatures or higher altitudes.

### DHCP

The *dynamic host configuration protocol* is an advanced extension of BOOTP. DHCP is a more advanced, but both DHCP and BOOTP are common. (DHCP can handle BOOTP client requests.)

### digital I/O

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

### DIN

*Deutsches Institut für Normung* is a German institution that sets engineering and dimensional standards.

## E

### electronic module

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

### EN

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

**encoder**

An *encoder* is a device for length or angular measurement (linear or rotary encoders).

**Ethernet**

*Ethernet* is a physical and data link layer technology for LANs, also known as IEE 802.3.

**expansion bus**

The *expansion bus* is an electronic communication bus between expansion modules and a CPU.

**expert I/O**

*Expert I/Os* are dedicated modules or channels for advanced features. These features are generally embedded in the module in order to not use the resources of the PLC Controller and to allow a fast response time, depending of the feature. Regarding the function, it could be considered as a “stand alone” module, because the function is independent of the Controller processing cycle, it just exchanges some information with the Controller CPU.

**F**

**FAST I/O**

*FAST I/Os* are specific I/Os with some electrical features (response time, for example) but the treatment of these channels is done by the Controller CPU.

**FE**

*Functional ground* is the point of a system or device that must be grounded to help prevent equipment damage.

**FG**

*frequency generator*

**firmware**

The *firmware* represents the operating system on a controller.

## H

### hot swapping

*Hot swapping* is the replacement of a component with a like component while the system remains operational. The replacement component begins to function automatically after it is installed.

### HSC

*high-speed counter.*

## I

### I/O

*input/output*

### IEC

The *international electrotechnical commission* is a non-profit and non-governmental international standards organization that prepares and publishes international standards for all electrical, electronic, and related technologies.

### input filter

An *input filter* is a special function that rejects input noises. It is useful for helping to minimize input noises and chatter in limit switches. All inputs provide a level of input filtering using the hardware. Additional filtering with software is also configurable through the programming or the configuration software.

### IP 20

*Ingress protection* rating according to IEC 60529. IP20 modules are protected against ingress and contact of objects larger than 12.5 mm. The module is not protected against harmful ingress of water.

## L

### LED

A *light emitting diode* is an indicator that lights up when electricity passes through it.

## M

### Modbus

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

## N

### NC

A *normally closed* contact is a contact pair that is closed when the actuator is de-energized (no power is applied) and open when the actuator is energized (power is applied).

### network

A network includes interconnected devices that share a common data path and protocol for communications.

## P

### PCI

A *peripheral component interconnect* is an industry-standard bus for attaching peripherals.

### PDM

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

### PE

*Protective ground* is a return line across the bus for fault currents generated at a sensor or actuator device in the control system.

**Profibus DP**

*Profibus Decentralised Peripheral* is a linear bus with a centralized access procedure of the Master/Slave type. Only Master stations, also known as active stations, have access rights to the bus. The Slave or passive stations can only respond to prompts. The physical connection is a single shielded twisted pair, but fiber optic interfaces are available to create tree, star, or ring structures. Compared to the ISO model, only layers 1, 2 are implemented, since access from the user interface is made directly to the link layer via simple mapping of variables.

**Pt100/Pt1000**

Platinum resistance thermometer are characterized by their nominal resistance  $R_0$  at a temperature of  $0^\circ \text{C}$ .

- Pt100 ( $R_0 = 100 \text{ Ohm}$ )
- Pt1000 ( $R_0 = 1 \text{ kOhm}$ )

**PWM**

*Pulse width modulation* is used for regulation processes (e.g. actuators for temperature control) where a pulse signal is modulated in its length. For these kind of signals, transistor outputs are used.

**R****RS-232**

*RS-232* (also known as EIA RS-232C or V.24) is a standard type of serial communication bus, based on three wires.

**RS-485**

*RS-485* (also known as EIA RS-485) is a standard type of serial communication bus, based on two wires.

**RTS**

*Request to send* is a data transmission signal and will be acknowledged by the CTS signal from the destination node.

**RxD**

*receiving data* (data transmission signal)

## S

### SEL-V

A system that follows IEC 61140 guidelines for *safety extra low voltage* is protected in such a way that voltage between any 2 accessible parts (or between 1 accessible part and the PE terminal for Class 1 equipment) does not exceed a specified value under normal conditions or under single-fault conditions.

### sink input

A *sink input* is a wiring arrangement in which the device provides current to the input electronic module. A sink input is referenced to 0 Vdc.

### SL

*serial line*

### source output

A *source output* is a wiring arrangement in which the output electronic module provides current to the device. A source output is referenced to +24 Vdc.

## T

### terminal block

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

### TxD

TxD represents a transmit signal.

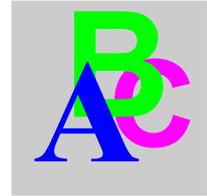
## U

### UL

*Underwriters laboratories*, US organization for product testing and safety certification.

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