Modicon TM5

Expansion Modules Configuration

Programming Guide

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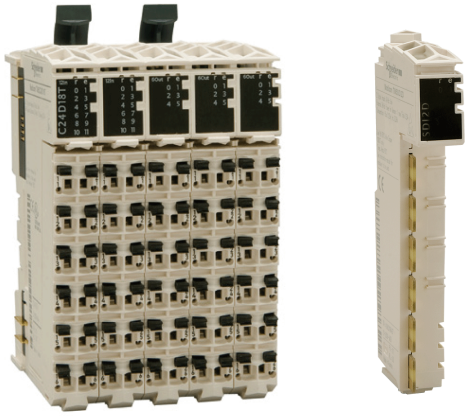

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Safety Information

Important Information

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

Document Scope

This manual describes the configuration of the Modicon TM5 Input/Output expansion modules. For further information, refer to the separate documents provided in the EcoStruxure Machine Expert online help.

Validity Note

This document has been updated for the release of EcoStruxure™ Machine Expert V2.2.

The characteristics that are described in the present document, as well as those described in the documents included in the Related Documents section below, can be found online. To access the information online, go to the Schneider Electric home page www.se.com/ww/en/download/.

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

Related Documents

Title of Documentation	Reference Number
Modicon TM5 IoDrvTM5SEAISG Strain Gauge Library Guide	EIO0000003185 (Eng) EIO0000003186 (Fre) EIO0000003187 (Ger) EIO0000003188 (Spa) EIO0000003189 (Ita) EIO0000003190 (Chs)
Modicon TM5 Compact I/O Modules Hardware Guide	EIO0000003191 (Eng) EIO0000003192 (Fre) EIO0000003193 (Ger) EIO0000003194 (Spa) EIO0000003195 (Ita) EIO0000003196 (Chs)
Modicon TM5 Digital I/O Modules Hardware Guide	EIO0000003197(Eng) EIO0000003198 (Fre) EIO0000003199 (Ger) EIO0000003200 (Spa) EIO0000003201 (Ita) EIO0000003202 (Chs)
Modicon TM5 Analog I/O Modules Hardware Guide	EIO0000003203 (Eng) EIO0000003204 (Fre) EIO0000003205 (Ger) EIO0000003206 (Spa) EIO0000003207 (Ita) EIO0000003208 (Chs)

Title of Documentation	Reference Number
Modicon TM5 Expert (High Speed Counter) Modules Hardware Guide	EIO0000003209 (Eng) EIO0000003210 (Fre) EIO0000003211 (Ger) EIO0000003212 (Spa) EIO0000003213 (Ita) EIO0000003214 (Chs)
Modicon TM5 Transmitter and Receiver Modules Hardware Guide	EIO0000003215 (Eng) EIO0000003216 (Fre) EIO0000003217 (Ger) EIO0000003218 (Spa) EIO0000003219 (Ita) EIO0000003220 (Chs)

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

Product Related Information

⚠WARNING

LOSS OF CONTROL

- Perform a Failure Mode and Effects Analysis (FMEA), or equivalent risk analysis, of your application, and apply preventive and detective controls before implementation.
- Provide a fallback state for undesired control events or sequences.
- Provide separate or redundant control paths wherever required.
- Supply appropriate parameters, particularly for limits.
- Review the implications of transmission delays and take actions to mitigate them.
- Review the implications of communication link interruptions and take actions to mitigate them.
- Provide independent paths for control functions (for example, emergency stop, over-limit conditions, and error conditions) according to your risk assessment, and applicable codes and regulations.
- Apply local accident prevention and safety regulations and guidelines.[1]
- Test each implementation of a system for proper operation before placing it into service.

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

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control* and to NEMA ICS 7.1 (latest edition), *Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems* or their equivalent governing your particular location.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

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

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

Terminology Derived from Standards

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

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

Among others, these standards include:

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

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

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

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

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

Information on Non-Inclusive or Insensitive Terminology

As a responsible, inclusive company, Schneider Electric is constantly updating its communications and products that contain non-inclusive or insensitive terminology. However, despite these efforts, our content may still contain terms that are deemed inappropriate by some customers.

I/O Configuration General Information

Introduction

This chapter provides general considerations to configure I/O expansion modules.

TM5 Expansion Modules General Description

Introduction

The range of expansion modules includes:

- TM5 Compact I/O modules with integrated electronic modules
- TM5 Digital I/O modules
- TM5 Analog I/O modules
- TM5 Temperature Analog modules
- TM5 Analog Strain modules
- TM5 Expert modules
- TM5 Transmitter - Receiver modules
- TM5 Power distribution modules
- TM5 Common distribution modules
- TM5 Communication Modules
- TM5 Dummy modules

Compact, digital, and analog input modules convert measured values (voltages, currents) into numerical values that can be processed by the controller.

Compact, digital, and analog output modules convert controller-internal numerical values into voltages or currents.

Expert modules are used for counting. They use either a Synchronous Serial Interface (SSI) encoder, incremental encoder, or event counting.

The transmitter and receiver modules handle the communication between remote modules via expansion bus cables.

Power distribution modules are used to manage the power supply for the various I/O modules.

Common distribution modules provide 0 Vdc and/or 24 Vdc terminal connections for the 24 Vdc I/O power segment(s) integrated into the bus bases, which expand the wiring possibilities for sensors and actuators.

The dummy module is a non-functional module. This module is used to separate modules which have specific thermal or EMC requirements, or as a placeholder for later system expansion.

The communication module is used to connect complex devices of the TM5. This communication module can only be used with the TM5NS31 Sercos interface module.

Compact I/O Expansion Features

Reference	Number of Channels	Voltage/Current
TM5C12D6T6L	12 digital inputs	24 Vdc / 3.75 mA
	6 digital outputs	24 Vdc / 0.5 A
	4 analog inputs	-10...+10 Vdc 0...20 mA/4...20 mA
	2 analog outputs	-10...+10 Vdc 0...20 mA
TM5C12D8T	12 digital inputs	24 Vdc / 3.75 mA
	8 digital outputs	24 Vdc / 0.5 A
TM5C24D12R	24 inputs	24 Vdc / 3.75 mA
	12 relays NO contact	24 Vdc / 230 Vac 2 A
TM5C24D18T	24 digital inputs	24 Vdc / 3.75 mA
	18 digital outputs	24 Vdc / 0.5 A
TM5CAI8O8CL	8 analog inputs	0...20 mA / 4...20 mA
	8 analog outputs	0...20 mA
TM5CAI8O8CVL	4 analog inputs	-10...+10 Vdc
	4 analog inputs	0...20 mA / 4...20 mA
	4 analog outputs	-10...+10 Vdc
	4 analog outputs	0...20 mA
TM5CAI8O8VL	8 analog inputs	-10...+10 Vdc
	8 analog outputs	-10...+10 Vdc

Digital I/O Expansion Features

Reference	Number of Channels	Voltage/Current
TM5SDI2D	2 inputs	24 Vdc / 3.75 mA
TM5SDI2DF	2 fast inputs	24 Vdc / 10.5 mA
TM5SDI4D	4 inputs	24 Vdc / 3.75 mA
TM5SDI6D	6 inputs	24 Vdc / 3.75 mA
TM5SDI12D	12 inputs	24 Vdc / 3.75 mA
TM5SDI16D	16 inputs	24 Vdc / 2.68 mA
TM5SDI2A	2 inputs	100...240 Vac
TM5SDI4A	4 inputs	100...240 Vac
TM5SDI6U	6 inputs	100...120 Vac
TM5SDO2T	2 outputs	24 Vdc / 0.5 A
TM5SDO4T	4 outputs	24 Vdc / 0.5 A
TM5SDO6T	6 outputs	24 Vdc / 0.5 A
TM5SDO12T	12 outputs	24 Vdc / 0.5 A
TM5SDO16T	16 outputs	24 Vdc / 0.5 A
TM5SDO4TA	4 outputs	24 Vdc / 2 A

Reference	Number of Channels	Voltage/Current
TM5SDO8TA	8 outputs	24 Vdc / 2 A
TM5SDO2R	2 relays C/O contact	30 Vdc / 230 Vac 5 A
TM5SDO4R	4 relays NO contact	30 Vdc / 230 Vac 5 A
TM5SDO2S	2 outputs	230 Vac / 1 A
TM5SDM12DT	8 inputs	24 Vdc / 7 mA
	4 outputs	24 Vdc / 0.5 A
TM5SMM6D2L	4 digital inputs	24 Vdc / 3.3 mA
	2 digital outputs	24 Vdc / 0.5 A
	1 analog input	-10...+10 Vdc 0...20 mA / 4...20 mA
	1 analog output	-10...+10 Vdc 0...20 mA

Analog I/O Expansion Features

Reference	Number of Channels	Voltage/Current
TM5SAI2L	2 inputs	-10...+10 Vdc 0...20 mA / 4...20 mA
TM5SAI4L	4 inputs	-10...+10 Vdc 0...20 mA / 4...20 mA
TM5SAI2H	2 inputs	-10...+10 Vdc 0...20 mA
TM5SAI4H	4 inputs	-10...+10 Vdc 0...20 mA
TM5SAO2L	2 outputs	-10...+10 Vdc 0...20 mA
TM5SAO2H	2 outputs	-10...+10 Vdc 0...20 mA
TM5SAO4L	4 outputs	-10...+10 Vdc 0...20 mA
TM5SAO4H	4 outputs	-10...+10 Vdc 0...20 mA

Temperature Analog Expansion Features

Reference	Number of Channels	Sensor Type
TM5SAI2PH	2 inputs	PT100/1000
TM5SAI4PH	4 inputs	PT100/1000
TM5SAI2TH	2 inputs	Thermocouple J, K, N, S
TM5SAI6TH	6 inputs	Thermocouple J, K, N, S

Analog Strain Gauge Input Electronic Module Features

Reference	Number of Channels	Sensor Type
TM5SEAISG	1 input	Full-bridge strain gauge

Expert Expansion Features

Reference	Number of Channels	Encoder Inputs
TM5SE1IC02505	1	5 Vdc Symmetrical
TM5SE1IC01024	1	24 Vdc Asymmetrical
TM5SE2IC01024	2	24 Vdc Asymmetrical
TM5SE1SC10005	1	5 Vdc Symmetrical
TM5SE1RS2	1	5 Vdc Symmetrical

Transmitter-Receiver Expansion Features

Reference	Modules Description
TM5SBET1	TM5 data transmitter electronic module.
TM5SBET7	TM5 data transmitter electronic module. It also distributes power to the TM7 bus.
TM5SBER2	TM5 data receiver electronic module. It also distributes power to the TM5 bus and to the 24 Vdc I/O power segment.

Power Distribution Expansion Features

Reference	Modules Description
TM5SPS1	24 Vdc I/O power segment supply
TM5SPS1F	24 Vdc I/O power segment supply with integrated fuse
TM5SPS2	24 Vdc I/O power segment supply and TM5 bus supply
TM5SPS2F	24 Vdc I/O power segment supply with integrated fuse and TM5 bus supply
TM5SPS3	FieldBus Interface 24 Vdc power supply

Common Distribution Expansion Features

Reference	Number of Channels	Voltage
TM5SPDG12F	12	0 Vdc
TM5SPDD12F	12	24 Vdc
TM5SPDG5D4F	2 x 5	0 Vdc - 24 Vdc
TM5SPDG6D6F	2 x 6	0 Vdc - 24 Vdc

Dummy Expansion Features

Reference	Number of Channels	Voltage
TM5SD000	–	–

Match Software and Hardware Configuration

The I/O that may be embedded in your controller is independent of the I/O that you may have added in the form of I/O expansion. It is important that the logical I/O configuration within your program matches the physical I/O configuration of your installation. If you add or remove any physical I/O to or from the I/O expansion bus or, depending on the controller reference, to or from the controller (in the form of cartridges), then you must update your application configuration. This is also true for any field bus devices you may have in your installation. Otherwise, there is the potential that the expansion bus or field bus no longer function while the embedded I/O that may be present in your controller continues to operate.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Update the configuration of your program each time you add or delete any type of I/O expansions on your I/O bus, or you add or delete any devices on your field bus.

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

Adding a TM5 Expansion Module

Refer to the TM5 Expansion Modules Configuration Programming Guide, page 14.

Adding an Expansion Module

Procedure

To add an expansion module to your controller or fieldbus interface, select the expansion module in the **Hardware Catalog**, drag it to the **Devices tree**, and drop it on one of the highlighted nodes.

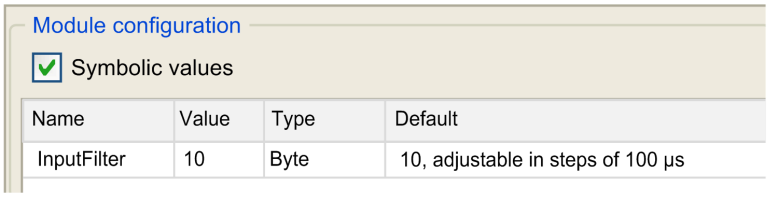
I/O Configuration

To configure the expansion module, double-click the expansion module you added in the **Devices tree**.

Result: The **TM5 Module I/O Mapping** window is displayed.

User-Defined Parameters Tab Description

Set the parameters of the expansion module using the **User-Defined Parameters** tab:

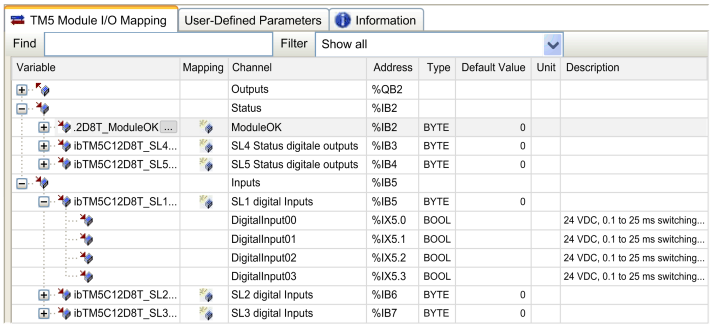


The **User-Defined Parameters** tab contains these columns:

Column	Description	Editable
Name	Parameter name	No
Value	Value of the parameter	Yes. An edit frame can be opened by double-clicking.
Type	Parameter data type	No
Default	Default parameter value	No

TM5 Module I/O Mapping Tab Description

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab:



The **TM5 Module I/O Mapping** tab contains these columns:

Column	Description
Variable	Lets you map the channel on a variable. Double-click the variable icon to enter the variable name. If it is a new variable, the variable is created. It is also possible to map an existing variable with the variables **Input Assistant** by clicking the input assistant button.
Mapping	Indicates if the channel is mapped on a new variable or an existing variable.
Channel	Name of the channel of the device.
Address	Address of the channel.
Type	Data type of the channel.
Unit	Unit of the channel value.
Description	Description of the channel.

The parameter **Always update variables** is set to **Enabled 1 (use bus cycle task if not used in any task)** and is not editable.

NOTE: %I value is updated from physical information at the beginning of each task using the **%I**.

Physical output level is updated from memory variable for the outputs value within the task configured by **Bus cycle task** configuration.

TM5 Compact I/O Modules

Introduction

This chapter provides information to configure compact I/O and their integrated electronic modules:

- TM5C24D18T with the 12In and 6Out electronic modules,
- TM5C12D8T with the 4In and 4Out electronic modules,
- TM5C24D12R with the 12In and 6Rel electronic modules,
- TM5CAI8O8VL with the 4AI ±10 V and 4AO ±10 V electronic modules,
- TM5CAI8O8CL with the 4AI 0-20 mA / 4-20 mA and 4AO 0-20 mA electronic modules,
- TM5CAI8O8CVL with the 4AI ±10 V, 4AI 0-20 mA / 4-20 mA, 4AO ±10 V and 4AO 0-20 mA electronic modules,
- TM5C12D6T6L with the 6In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA and 2AO ±10 V / 0-20 mA electronic modules.

To add the expansion electronic modules contained in the compact I/O modules, and to access the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5 Compact I/O Modules

Introduction

This section shows you how to configure the compact I/O modules.

TM5C24D18T

Introduction

The TM5C24D18T compact I/O module is a set of 5 TM5 24 Vdc input and output electronic modules assembled together.

This set includes:

- 2 digital input electronic modules
- 3 digital output electronic modules

For further information, refer to the TM5C24D18T General Description (see Modicon TM5, Compact I/O Modules, Hardware Guide).

General Description

To configure the TM5C24D18T compact I/O module, select the **User-Defined Parameters** tab.

This table describes the **General** parameters of the TM5C24D18T compact I/O module:

Parameter	Value	Default Value	Description
Module address	0...250	0	The address is automatically set when adding the compact I/O modules. The address value depends on the order of adding the module in the **Devices tree**. The compact I/O module does not support the possibility to change the address.

Set each of the I/O electronic modules individually using the **SL.xx - SDEM** (SDEM = Short Description of the Electronic Module, like 12In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA etc.) folders available.

NOTE:

- **SL** stands for the position of the electronic module within the compact I/O module.
- **xx** is the index number of the electronic module position (from 1 to 5).

The table below provides the I/O electronic module type associated with the positions 1 to 5 on the TM5C24D18T compact I/O module:

I/O Electronic Module Position	Type	Refer to
SL1	12 digital inputs	Configuration of the input 12In electronic modules.
SL2	12 digital inputs	
SL3	6 digital outputs	Configuration of the digital output 6Out electronic modules.
SL4	6 digital outputs	
SL5	6 digital outputs	

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 18, for the output parameters configuration details.
- Status Mapping, page 19 for the status bits configuration details
- Input Mapping, page 20, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Output Mapping

This table describes the TM5C24D18T output mapping configuration:

Channel	Type	Description
SL3_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL3**
DigitalOutput00	BOOL	Command bit of output 0
...		...
DigitalOutput05		Command bit of output 5
SL4_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL4**
DigitalOutput00	BOOL	Command bit of output 0
...		...
DigitalOutput05		Command bit of output 5
SL5_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL5**
DigitalOutput00	BOOL	Command bit of output 0
...		...
DigitalOutput05		Command bit of output 5

Status Bit Mapping

This table describes the TM5C24D18T status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status_digital_outputs_SL3	USINT	Status word of all outputs of the integrated electronic module located at **SL3**
StatusDigitalOutput00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
...		
StatusDigitalOutput05		
Status_digital_outputs_SL4	USINT	Status word of all outputs of the integrated electronic module located at **SL4**
StatusDigitalOutput00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
...		
StatusDigitalOutput05		
Status_digital_outputs_SL5	USINT	Status word of all outputs of the integrated electronic module located at **SL5**

	StatusDigitalOutput00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
	...		
	StatusDigitalOutput05		

Input Mapping

This table describes the TM5C24D18T input mapping configuration:

Channel	Type	Description
SL1DigitalInputs_1_8	BYTE	State of all inputs (bits 12-15 = 0, not used) of the integrated electronic module located at **SL1**
DigitalInput00	BOOL	State of input 0
...		...
DigitalInput07		State of input 7
SL1DigitalInputs_9_12	UINT	State of all inputs (bits 12-15 = 0, not used) of the integrated electronic module located at **SL2**
DigitalInput08	BYTE	State of input 0
...		...
DigitalInput11		State of input 11

User-Defined Parameters Tab

This table describes the TM5C24D18T user-defined parameters configuration:

Name	Value	Default Value	Description
SL1_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127
SL2_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127

TM5C12D8T

Introduction

The TM5C12D8T compact I/O module is a set of 5 TM5 24 Vdc input and output electronic modules assembled together.

This set includes:

- 3 digital input electronic modules
- 2 digital output electronic modules

For further information, refer to the TM5C12D8T General Description (see Modicon TM5, Compact I/O Modules, Hardware Guide).

General Description

To configure the TM5C12D8T compact I/O module, select the **User-Defined Parameters** tab.

This table describes the **General** parameters of the TM5C12D8T compact I/O module:

Parameter	Value	Default Value	Description
Module address	0...250	0	The address is automatically set when adding the compact I/O modules. The address value depends on the order of adding the module in the **Devices tree**. The compact I/O module does not support the possibility to change the address.

Set each of the I/O electronic modules individually using the **SL.xx - SDEM** (SDEM = Short Description of the Electronic Module, like 12In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA etc.) folders available.

NOTE:

- **SL** stands for the position of the electronic module within the compact I/O module.
- **xx** is the index number of the electronic module position (from 1 to 5).

This table provides the I/O electronic module type associated with the positions 1 to 5 on the TM5C12D8T compact I/O module:

I/O Electronic Module Position	Type	Refer To
SL1	4 digital inputs	Configuration of the digital input 4In electronic modules.
SL2	4 digital inputs	
SL3	4 digital inputs	
SL4	4 digital outputs	Configuration of the digital output 4Out electronic modules.
SL5	4 digital outputs	

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 21, for the output parameters configuration details.
- Status Mapping, page 22 for the status bits configuration details.
- Input Mapping, page 22, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Output Mapping

This table describes the TM5C12D8T output mapping configuration:

Channel	Type	Description
SL4_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL4** (bits 4...7: not used).
DigitalOutput00	BOOL	Command bit of output 0
...		...
DigitalOutput03		Command bit of output 3
SL5_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL5** (bits 4...7: not used).
DigitalOutput00	BOOL	Command bit of output 0
...		...

Channel	Type	Description
DigitalOutput03		Command bit of output 3

Status Mapping

This table describes the TM5C12D8T status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

SL4_StatusDigitalOutputs		BYTE	Status word of all outputs of the integrated electronic module located at **SL4** (bits 4...7: not used).
	StatusDigitalOutput00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
	...		
	StatusDigitalOutput03		
SL5_StatusDigitalOutputs		BYTE	Status word of all outputs of the integrated electronic module located at **SL5** (bits 4...7: not used).
	StatusDigitalOutput00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
	...		
	StatusDigitalOutput03		

Input Mapping

This table describes the TM5C12D8T input mapping configuration:

Channel		Type	Description
SL1_DigitalInputs		BYTE	State of all inputs (bits 4-7 = 0, not used) of the integrated electronic module located at **SL1**
	DigitalInput00	BOOL	State of input 0
	...		...
	DigitalInput03		State of input 03
SL2_DigitalInputs		BYTE	State of all inputs (bits 4-7 = 0, not used) of the integrated electronic module located at **SL2**
	DigitalInput00	BOOL	State of input 0
	...		...
	DigitalInput03		State of input 3

Channel		Type	Description
SL3_DigitalInputs		BYTE	State of all inputs (bits 4-7 = 0, not used) of the integrated electronic module located at **SL3**
	DigitalInput00	BOOL	State of input 0
	...		...
	DigitalInput03		State of input 3

User-Defined Parameters

This table describes the TM5C12D8T user-defined parameters configuration:

Name	Value	Default Value	Description
SL1_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127
SL2_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127
SL3_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127

TM5C12D6T6L

Introduction

The TM5C12D6T6L compact I/O module is a set of 5 TM5 24 Vdc input and output electronic modules assembled together.

This set includes:

- 2 digital input electronic modules
- 1 digital output electronic module
- 1 analog input electronic module
- 1 analog output electronic module

For further information, refer to the TM5C12D6T6L General Description (see Modicon TM5, Compact I/O Modules, Hardware Guide).

General Description

To configure the TM5C12D6T6L compact I/O module, select the **User-Defined Parameters** tab.

This table describes the **General** parameters of the TM5C12D6T6L compact I/O module:

Parameter	Value	Default Value	Description
Module address	0...250	0	The address is automatically set when adding the compact I/O modules. The address value depends on the order of adding the module in the **Devices tree**. The compact I/O module does not support the possibility to change the address.

Set each of the I/O electronic modules individually using the **SL - SDEM** (SDEM = Short Description of the Electronic Module, like 12In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA etc.) folders available.

NOTE:

- **SL** stands for the position of the electronic module on the compact I/O electronic module.
- **xx** is the index number of the electronic module position (from 1 to 5).

This table provides the I/O electronic module type associated with the positions 1 to 5 on the TM5C12D6T6L compact I/O module:

I/O Electronic Module Position	Type	Refer To
SL1	6 digital inputs	Configuration of the digital input 6In electronic modules.
SL2	6 digital inputs	
SL3	6 digital outputs	Configuration of the digital output 6Out electronic module.
SL4	4 analog inputs	Configuration of the analog input 4AI ±10 V electronic module.
SL5	2 analog outputs	Configuration of the analog output 2AO ±10 V / 0-20 mA electronic module.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 24, for the output parameters configuration details.
- Status Mapping, page 24 for the status bits configuration details
- Input Mapping, page 25, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Output Mapping

This table describes the TM5C12D6T6L output mapping configuration:

Channel	Type	Description
SL3_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL3** (bits 6...7: not used).
DigitalOutput00 ... **DigitalOutput05**	BOOL	Command bit of output 0...5.
SL5_AnalogOutput01	INT	Command word of the output 0
SL5_AnalogOutput02	INT	Command word of the output 1

Status Mapping

This table describes the TM5C12D6T6L status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

SL4 Status		BYTE	Diagnostic of **SL4** analog input.
	Bit0 ... **Bit7**	BOOL	Temperature bits: • 00: No error detected • 01: Below lower limit value • 10: Above upper limit value • 11: Wire break

Input Mapping

This table describes the TM5C12D6T6L input mapping configuration:

Channel		Type	Description
SL1_DigitalInputs		BYTE	State of all inputs (bits 6-7 = 0, not used) of the integrated electronic module located at **SL1**
	DigitalInput00 ... **DigitalInput05**	BOOL	State of input 0...5.
SL2_DigitalInputs		BYTE	State of all inputs (bits 6-7 = 0, not used) of the integrated electronic module located at **SL2**
	DigitalInput00 ... **DigitalInput05**	BOOL	State of input 0...5.
SL4_AnalogInput00 ... **SL4_AnalogInput03**		BYTE	Value of input 0...3.

User-Defined Parameters Tab

This table describes the TM5C12D6T6L user-defined parameters configuration:

Name	Value	Default Value	Description
SL1_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127 10, adjustable in steps of 100 µs.
SL2_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127 10, adjustable in steps of 100 µs.
SL4_InputFilter	off level 2 level 4 level 8 level 16 level 32 level 64 level 128	off	Specifies the filter time of all digital inputs.
SL4_InputLimitation	16383 off 4095 511 8191 1023 2047 255	16383	Defines the input ramp limitation of the input filter.
SL4_ChannelType01 ... **SL4_ChannelType04**	-10 V to +10 V 0 to 20 mA	-10 V to +10 V	Specifies the channel type.
SL4_LowerLimit	-32768...32767	-32767	Specifies the lower measurement limit (see Modicon TMC4, Cartridges, Programming Guide).
SL4_UpperLimit	-32768...32767	32767	Specifies the upper measurement limit (see Modicon TMC4, Cartridges, Programming Guide).
SL5_ChannelType01 **SL5_ChannelType02**	-10 V to +10 V 0 to 20 mA	-10 V to +10 V	Specifies the channel type.

TM5C24D12R

Introduction

The TM5C24D12R compact I/O module is a set of 5 TM5 24 Vdc input and output electronic modules assembled together.

This set includes:

- 2 digital input electronic modules
- 2 relay electronic modules

- 1 dummy module (see Modicon TM5, Compact I/O Modules, Hardware Guide).

For further information, refer to the TM5C24D12R General Description (see Modicon TM5, Compact I/O Modules, Hardware Guide).

General Description

To configure the TM5C24D12R compact I/O module, select the **User-Defined Parameters** tab.

This table describes the **General** parameters of the TM5C24D12R compact I/O module:

Parameter	Value	Default Value	Description
Module address	0...250	0	The address is automatically set when adding the compact I/O modules. The address value depends on the order of adding the module in the **Devices tree**. The compact I/O module does not support the possibility to change the address.

Set each of the I/O electronic modules individually using the **SL.xx - SDEM** (SDEM = Short Description of the Electronic Module, like 12In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA etc.) folders available.

NOTE:

- **SL** stands for the position of the electronic module within the compact I/O module.
- **xx** is the index number of the electronic module position (from 1 to 3, 5).

This table provides the I/O electronic module type associated with the positions from 1 to 3, 5 on the TM5C24D12R compact I/O module:

I/O Electronic Module Position	Type	Refer To
SL1	12 digital inputs	Configuration of the digital input 12In electronic modules.
SL2	12 digital inputs	
SL3	6 relay outputs	Configuration of the digital output relay 6Rel electronic modules.
SL5	6 relay outputs	

NOTE: SL4 does not appear in the **User-Defined Parameters** tab as this is the dummy module that cannot be configured.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 24, for the output parameters configuration details.
- Status Mapping, page 24 for the status bits configuration details
- Input Mapping, page 25, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Output Mapping

This table describes the TM5C24D12R output mapping configuration:

Channel		Description
SL3_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL3**
DigitalOutput00	BOOL	Command bit of output 0
...		...
DigitalOutput05		Command bit of output 5
SL5_DigitalOutputs	BYTE	Command word of all outputs of the integrated electronic module located at **SL5**
DigitalOuput00	BOOL	Command bit of output 0
...		...
DigitalOutput05		Command bit of output 5

Status Bit Mapping

This table describes the TM5C24D12R status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping

This table describes the TM5C24D12R input mapping configuration:

Channel	Type	Description
SL1_DigitalInputs	BYTE	State of all inputs (bits 12-15 = 0, not used) of the integrated electronic module located at **SL1**
DigitalInput00	BOOL	State of input 0
...		...
DigitalInput11		State of input 11
SL2_DigitalInputs	BYTE	State of all inputs (bits 12-15 = 0, not used) of the integrated electronic module located at **SL2**
DigitalInput00	BOOL	State of input 0
...		...

Channel		Type	Description
	DigitalInput11		State of input 11

User-Defined Parameters Tab

This table describes the TM5C24D12R user-defined parameters configuration:

Name	Value	Default Value	Description
SL1_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127
SL2_InputFilter	0...127	10	Specifies the filter time of all digital inputs in the range 0...127

TM5CAI8O8VL

Introduction

The TM5CAI8O8VL compact I/O module is a set of 4 TM5 24 Vdc input and output electronic modules assembled together.

This set includes:

- 2 analog input electronic module
- 1 dummy module (see Modicon TM5, Compact I/O Modules, Hardware Guide)
- 2 analog output electronic module

For further information, refer to the TM5CAI8O8VL General Description, page 29.

General Description

To configure the TM5CAI8O8VL compact I/O module, select the **User-Defined Parameters** tab.

This table describes the **General** parameters of the TM5CAI8O8VL compact I/O module:

Parameter	Value	Default Value	Description
Module address	0...250	0	The address is automatically set when adding the compact I/O modules. The address value depends on the order of adding the module in the **Devices tree**. The compact I/O modules does not support the possibility to change the address.

Set each of the I/O electronic modules individually using the **SL.xx - SDEM** (SDEM = Short Description of the Electronic Module, like 12In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA etc.) folders available.

NOTE:

- **SL** stands for the position of the electronic module on the compact I/O module.
- **xx** is the index number of the electronic module position (1, 2, 4, 5).

This table provides the I/O electronic module type associated with the positions 1, 2, 4, 5 on the TM5CAI8O8VL compact I/O module:

I/O Electronic Module Position	Type	Refer to
SL1	4 analog inputs	Configuration of the analog input 4AI ±10 V electronic modules.
SL2	4 analog inputs	
SL4	4 analog outputs	Configuration of the analog output 4AO ±10 V electronic module.
SL5	4 analog outputs	

NOTE: SL3 does not appear in the **User-Defined Parameters** tab as this is the dummy module that cannot be configured.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 30, for the output parameters configuration details.
- Status Mapping, page 30 for the status bits configuration details
- Input Mapping, page 31, for the input parameters configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Description, page 15.

Output Mapping

This table describes the TM5CAI8O8VL output mapping configuration:

Channel		Description
SL4 Analogue Output00	INT	Value of input 0
...		...
SL4 Analogue Output03		Value of input 3
SL5 Analogue Output00	INT	Value of input 0
...		...
SL5 Analogue Output03		Value of input 3

Status Bit Mapping

This table describes the TM5CAI8O8VL status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid

Channel	Type	Description
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status Analogue Input SL1	BYTE	Temperature status
Bit0 SL1 Analogue Input 00 ... **Bit7 SL1 Analogue Input 03**	BOOL	Temperature bits: • 00: No error detected • 01: Below lower limit value • 10: Above upper limit value • 11: Wire break
Status Analogue Input SL2	BYTE	Temperature status
Bit0 SL2 Analogue Input 00 ... **Bit7 SL2 Analogue Input 03**	BOOL	Temperature bits: • 00: No error detected • 01: Below lower limit value • 10: Above upper limit value • 11: Wire break

Input Mapping

This table describes the TM5CAI8O8VL input mapping configuration:

Channel	Type	Description
SL1 Analogue Input 00	INT	Value of input 0
...		...
SL1 Analogue Input 03		Value of input 3
SL2 Analogue Input 00	INT	Value of input 0
...		...
SL2 Analogue Input 03		Value of input 3

User-Defined Parameters Tab

There is no user configuration for this module.

TM5CAI8O8CL

Introduction

The TM5CAI8O8CL compact I/O module is a set of 4 TM5 24 Vdc input and output electronic modules assembled together.

This set includes:

- 2 analog input electronic modules
- 1 dummy module (see Modicon TM5, Compact I/O Modules, Hardware Guide)
- 2 analog output electronic modules

For further information, refer to the TM5CAI8O8CL General Description (see Modicon TM5, Compact I/O Modules, Hardware Guide).

General Description

To configure the TM5CAI8O8CL compact I/O module, select the **User-Defined Parameters** tab.

This table describes the **General** parameters of the TM5CAI8O8CL compact I/O module:

Parameter	Value	Default Value	Description
Module address	0...250	0	The address is automatically set when adding the compact I/O modules. The address value depends on the order of adding the module in the **Devices tree**. The compact I/O modules does not support the possibility to change the address.

Set each of the I/O electronic modules individually using the **SL.xx - SDEM** (SDEM = Short Description of the Electronic Module, like 12In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA etc.) folders available.

NOTE:

- **SL** stands for the position of the electronic module on the compact I/O electronic module.
- **xx** is the index number of the electronic module position (1, 2, 4, 5).

This table provides the I/O electronic module type associated with the positions 1, 2, 4, 5 on the TM5CAI8O8CL compact I/O module:

I/O Electronic Module Position	Type	Refer To
SL1	4 analog inputs	Configuration of the analog input 4AI 0-20 mA / 4-20 mA electronic modules.
SL2	4 analog inputs	
SL4	4 analog outputs	Configuration of the analog output 4AO 0-20 mA electronic module.
SL5	4 analog outputs	

NOTE: SL3 does not appear in the **User-Defined Parameters** tab as this is the dummy module that cannot be configured.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 32, for the output parameters configuration details.
- Status Mapping, page 33 for the status bits configuration details
- Input Mapping, page 33, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Output Mapping

This table describes the TM5CAI8O8CL output mapping configuration:

Channel	Type	Description
SL4 Analogue Output 00 ... **SL4 Analogue Output 03**	INT	Command word of the output 0...3.
SL5 Analogue Output 00 ... **SL5 Analogue Output 03**	INT	Command word of the output 0...3.

Status Bit Mapping

This table describes the TM5CAI8O8CL status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status Analogue Input SL1		BYTE	Temperature status
	Bit0 SL1 Analogue Input 00 ... **Bit7 SL1 Analogue Input 03**	BOOL	Temperature bits: • 00: No error detected • 01: Below lower limit value • 10: Above upper limit value • 11: Wire break
Status Analogue Input SL2		BYTE	Temperature status
	Bit0 SL2 Analogue Input 00 ... **Bit7 SL2 Analogue Input 03**	BOOL	Temperature bits: • 00: No error detected • 01: Below lower limit value • 10: Above upper limit value • 11: Wire break

Input Mapping

This table describes the TM5CAI8O8CL input mapping configuration:

Channel	Type	Description
SL4 Analogue Input 00 ... **SL4 Analogue Input 03**	INT	Value of input 0...3
SL5 Analogue Input 00 ... **SL5 Analogue Input 03**	INT	Value of input 0...3

User-Defined Parameters Tab

This table describes the TM5CAI8O8CL user-defined parameters configuration:

Name	Value	Default Value	Description
SL1_ChannelType01 ... **SL1_ChannelType04**	0 to 20 mA 4 to 20 mA	0 to 20 mA	Specifies the channel type.
SL2_ChannelType01 ... **SL2_ChannelType04**	0 to 20 mA 4 to 20 mA	0 to 20 mA	Specifies the channel type.
SL4_ChannelType01 ... **SL4_ChannelType04**	0 to 20 mA	-	Specifies the channel type.
SL5_ChannelType01 ... **SL5_ChannelType04**	0 to 20 mA	-	Specifies the channel type.

TM5CAI8O8CVL

Introduction

The TM5CAI8O8CVL compact I/O module is a set of 4 TM5 24 Vdc input and output electronic modules assembled together.

This set includes:

- 2 analog input electronic modules
- 1 dummy module (see Modicon TM5, Compact I/O Modules, Hardware Guide)
- 2 analog output electronic modules

For further information, refer to the TM5CAI8O8CVL General Description (see Modicon TM5, Compact I/O Modules, Hardware Guide).

General Description

To configure the TM5CAI8O8CVL compact I/O module, select the **User-Defined Parameters** tab.

This table describes the **General** parameters of the TM5CAI8O8CVL compact I/O module:

Parameter	Value	Default Value	Description
Module address	0...250	0	The address is automatically set when adding the compact I/O modules. The address value depends on the order of adding the module in the **Devices tree**. The compact I/O modules does not support the possibility to change the address.

Set each of the I/O electronic modules individually using the **SL.xx - SDEM** (SDEM = Short Description of the Electronic Module, like 12In, 6Out, 4AI ±10 V / 0-20 mA / 4-20 mA etc.) folders available.

NOTE:

- **SL** stands for the position of the electronic module on the compact I/O electronic module.
- **xx** is the index number of the electronic module position (1, 2, 4, 5).

This table provides the I/O electronic module type associated with the positions 1, 2, 4, 5 on the TM5CAI8O8CVL compact I/O module:

I/O Electronic Module Position	Type	Refer To
SL1	4 analog inputs	Configuration of the analog input 4AI ±10 V electronic modules.
SL2	4 analog inputs	Configuration of the analog input4AI 0-20 mA / 4-20 mA electronic modules.
SL4	4 analog outputs	Configuration of the analog output 4AO ±10 V electronic module.
SL5	4 analog outputs	Configuration of the analog output 4AO 0-20 mA electronic module.

NOTE: SL3 does not appear in the **User-Defined Parameters** tab as this is the dummy module that cannot be configured.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 35, for the output parameters configuration details.
- Status Mapping, page 36 for the status bits configuration details
- Input Mapping, page 36, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Output Mapping

This table describes the TM5CAI8O8CVL output mapping configuration:

Channel	Type	Description
SL4_AnalogOutput00 ... **SL4_AnalogOutput03**	INT	Command word of the output 0...3.
SL5_AnalogOutput00 ... **SL5_AnalogOutput03**	INT	Command word of the output 0...3.

Status Bit Mapping

This table describes the TM5CAI8O8CVL status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status Analogue Input SL1		BYTE	Temperature status
	Bit0 SL1 Analogue Input 00 ... **Bit7 SL1 Analogue Input 03**	BOOL	Temperature bits: • 00: No error detected • 01: Below lower limit value • 10: Above upper limit value • 11: Wire break
Status Analogue Input SL2		BYTE	Temperature status
	Bit0 SL2 Analogue Input 00 ... **Bit7 SL2 Analogue Input 03**	BOOL	Temperature bits: • 00: No error detected • 01: Below lower limit value • 10: Above upper limit value • 11: Wire break

Input Mapping

This table describes the TM5CAI8O8CVL input mapping configuration:

Channel	Type	Description
SL4_AnalogInput00 ... **SL4_AnalogInput03**	INT	Value of input 0...3.
SL5_AnalogInput00 ... **SL5_AnalogInput03**	INT	Value of input 0...3.

User-Defined Parameters Tab

This table describes the TM5CAI8O8CVL user-defined parameters configuration:

Name	Value	Default Value	Description
SL2_ChannelType01 ... **SL2_ChannelType04**	0 to 20 mA 4 to 20 mA	0 to 20 mA	Specifies the channel type.
SL5_ChannelType01 ... **SL5_ChannelType04**	0 to 20 mA	-	Specifies the channel type.

TM5 Digital I/O Electronic Modules

Introduction

This chapter provides information to configure digital I/O expansion electronic modules.

To add expansion electronic modules, and to access the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5SDI2D, TM5SDI4D and TM5SDI6D

Introduction

The TM5SDI2D, TM5SDI4D and TM5SDI6D expansion electronic modules are 24 Vdc digital input electronic modules with 2, 4 and 6 inputs respectively.

For further information, refer to the hardware guide:

Reference	Refer to
TM5SDI2D	TM5SDI2D Electronic Module 2DI 24 Vdc Sink 3 Wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDI4D	TM5SDI4D Electronic Module 4DI 24 Vdc Sink 3 Wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDI6D	TM5SDI6D Electronic Module 6DI 24 Vdc Sink 2 Wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Status Mapping, page 38, for the status bits configuration details.
- Input Mapping, page 39, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDI2D, TM5SDI4D, and TM5SDI6D status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK

Channel	Type	Description
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping

This table describes the TM5SDI2D, TM5SDI4D, and TM5SDI6D input mapping configuration:

Channel		Type	Description
DigitalInputs		BYTE	State of all inputs
	DigitalInput00	BOOL	State of input 0
	...		...
	DigitalInput05 (1)		State of input 5
(1) The number of digital inputs is equal to the module input number.			

User-Defined Parameters Tab

This table describes the TM5SDI2D, TM5SDI4D, and TM5SDI6D user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilter	0...12-7	10	Specifies the filter time of all digital inputs, adjustable in steps of 100 µs.

TM5SDI2A, TM5SDI4A and TM5SDI6U

Introduction

The TM5SDI2A, TM5SDI4A and TM5SDI6U expansion electronic modules are 100-240 Vac Input electronic modules with 2, 4 and 6 inputs respectively.

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SDI2A	TM5SDI2A Electronic Module 2DI 100 ... 240 Vac 3 Wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDI4A	TM5SDI4A Electronic Module 4DI 100 ... 240 Vac 2 Wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDI6U	TM5SDI6U Electronic Module 6DI 100 ... 120 Vac 1 Wire (see Modicon TM5, Digital I/O Modules, Hardware Guide)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Status Mapping, page 40, for the status bits configuration details.
- Input Mapping, page 40, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDI2D, TM5SDI4D, and TM5SDI6D status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping Tab

This table describes the TM5SDI2A, TM5SDI4A, and TM5SDI6U input mapping configuration:

Channel		Type	Description
DigitalInputs		BYTE	State of all inputs
	DigitalInput00	BOOL	State of input 0
	...		...
	DigitalInput05 (1)		State of input 5
	reserved	BOOL	reserved
	PowerSupply	BOOL	Status bit associated to external power supply: • 0: no AC external power supply or < 85 Vac • 1: AC external power supply OK
(1) The number of digita inputs bit is equal to the module input number.			

User-Defined Parameters Tab

This table describes the TM5SDI2A, TM5SDI4A, and TM5SDI6U user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilter	0...12-7	10	Specifies the filter time of all digital inputs, adjustable in steps of 100 µs.

TM5SDI12D

Introduction

The TM5SDI12D expansion electronic module is a 24 Vdc Digital Inputs electronic module with 12 inputs.

For further information, refer to TM5SDI12D Electronic Module 12DI 24 Vdc Sink 1 Wire (see Modicon TM5, Digital I/O Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Status Mapping, page 41, for the status bits configuration details.
- Input Mapping, page 42, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDI12D status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping Tab

This table describes the TM5SDI12D input mapping configuration:

Channel		Type	Description
DigitalInputs		BYTE	State of all inputs
	DigitalInput00	BOOL	State of input 0
	...		...
	DigitalInput11		State of input 11

User-Defined Parameters Tab

This table describes the TM5SDI12D user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilter	0...12-7	10	Specifies the filter time of all digital inputs, adjustable in steps of 100 µs.

TM5SDI16D

Introduction

The TM5SDI16D expansion electronic module is a 24 Vdc Digital Inputs electronic module with 16 inputs.

For further information, refer to TM5SDI16D Electronic Module 16DI 24 Vdc Sink 1 Wire (see Modicon TM5, Digital I/O Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Status Mapping, page 42, for the status bits configuration details.
- Input Mapping, page 43, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDI16D status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved

Channel	Type	Description
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping

This table describes the TM5SDI16D input mapping configuration:

Channel		Type	Description
DigitalInputs		BYTE	State of all inputs
	DigitalInput00	BOOL	State of input 0
	...		...
	DigitalInput15		State of input 15

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SDI16D user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilter	0...127	10	Specifies the filter time of all digital inputs, adjustable in steps of 100 µs.

TM5SDI2DF

Introduction

The TM5SDI2DF expansion electronic module is a 24 Vdc input electronic module with 2 fast inputs.

For further information, refer to TM5SDI2DF Electronic Module 2DI 24 Vdc Sink 3-Wire (see Modicon TM5, Digital I/O Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Status Mapping, page 44, for the status bits configuration details.

- Input Mapping, page 44, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDI2DF status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping

This table describes the TM5SDI2DF input mapping configuration:

Channel		Type	Description
DigitalInputs	**DigitalInput 0-1**	BYTE	State of all inputs
	DigitalInputs00	BOOL	State of input 0
	DigitalInputs01	BOOL	State of input 1
Counter00		UINT	Event counter or gate measurement
Counter01		UINT	Event counter or gate measurement

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SDI2DF user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilter	0...127	10	Specifies the filter time of all digital inputs, adjustable in steps of 100 µs.

Counter Mode

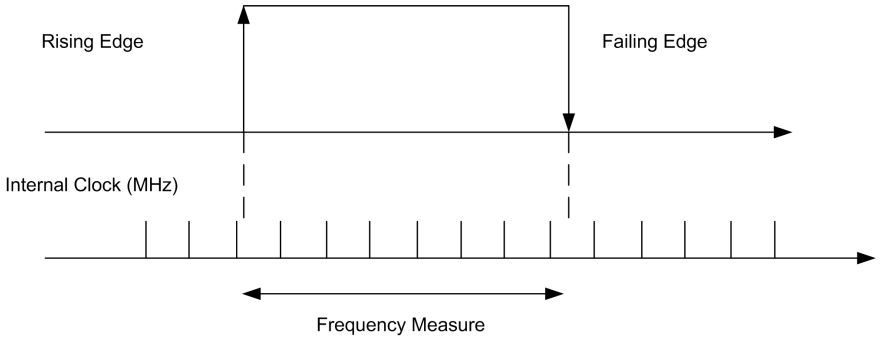
2 counter modes can be used with the TM5SDI2DF electronic module:

- Event counter operation - consists of transferring the counter status, registered with a fixed offset with respect to the bus cycle, and is transferred in the same cycle.

  NOTE: The rising edges are registered on the counter input.

- Gate measurement - consists of using an internal frequency to register the necessary time to reach the gate input.

  The following figure describes the gate measuring principle:



The TM5SDI2DF value is defined by the following equation:

$$SP = \frac{VT}{CF}$$

Where:

SP = Size of Pulse to be measured.

VT = Value of TM5SDI2DF.

CF = Clock Frequency.

For example: For a Clock Frequency at 3 Mhz and a Size of Pulse to be measured = 15 ms, the value of TM5SDI2DF is near 45000.

NOTE:

- Only one of the counter channels can be used for gate measurement at any one time.
- The time between rising and falling edges for the gate input is registered using an internal frequency. The result is verified for overflow (FFFF hex).
- The recovery time between measurements must be > 100 µs.
- The measurement result is transferred with the falling edge to the result memory.

The following table gives the maximum Size of Pulse to be measured depending on the Count Frequency parameter:

Maximum Size of Pulse	Clock Frequency
1.3653125 ms	48 MHz
2.730625 ms	24 MHz
5.46125 ms	12 MHz
10.9225 ms	6 MHz
21.845 ms	3 MHz
43.69 ms	1.5 MHz
87.38 ms	0.75 MHz
174.76 ms	0.375 MHz
354.2432432 ms	0.185 MHz

For example: For a Clock Frequency at 48 Mhz, the maximum Size of Pulse to be measured = 1.3 ms.

Where VTmax = 65534 :
SPmax = VTmax / CF
SPmax = 65534 / 48*10E6
SPmax = 0.001365
SPmax = 1.3 ms

Additional Function Input Latch

Using this function, the positive edges of the input signal can be latched with a resolution of 200 µs. With the “Acknowledge - input latch” function, the input latch is either reset or prevented from latching.

It works in the same way as a dominant reset RS flip-flop:

R: Status03	S: Status02	Q	Status
0	0	x	Do not change
0	1	1	Set
1	0	0	Reset
1	1	0	Reset

TM5SDO2T, TM5SDO4T, TM5SDO6T, TM5SDO12T, and TM5SDO16T

Introduction

The TM5SDO2T, TM5SDO4T, TM5SDO6T, TM5SDO12T and TM5SDO16T expansion electronic modules are 24 Vdc Digital Outputs electronic modules with 2, 4, 6, 12 or 16 outputs respectively.

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SDO2T	TM5SDO2T Electronic Module 2DO 24 Vdc Tr 0.5 A 3 Wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDO4T	TM5SDO4T Electronic Module 4DO 24 Vdc Tr 0.5 A 3 wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDO6T	TM5SDO6T Electronic Module 6DO 24 Vdc Tr 0.5 A 2 wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDO12T	TM5SDO12T Electronic Module 12DO 24 Vdc Tr 0.5 A 1 wire (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDO16T	TM5SDO16T Electronic Module 16DO 24 Vdc Tr 0.5 A 1 wire (see Modicon TM5, Digital I/O Modules, Hardware Guide)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 47, for the output parameters configuration details.
- Status Mapping, page 47, for the status bits configuration details.
- Input Mapping, page 48, for the input parameters configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Output Mapping

This table describes the TM5SDO2T, TM5SDO4T, TM5SDO6T, TM5SDO12T, and TM5SDO16T output mapping configuration:

Channel		Type	Description
DigitalOutputs		BYTE	Command word of all outputs
	DigitalOutput00	BOOL	Command bit of output 0
	...		...
	DigitalOutput15(1)		Command bit of output 15
(1) The number of digital outputs bit is equal to the module output number.			

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDO2T, TM5SDO4T, TM5SDO6T, TM5SDO12T, and TM5SDO16T status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping

This table describes the TM5SDO2T, TM5SDO4T, TM5SDO6T, TM5SDO12T, and TM5SDO16T input mapping configuration:

Channel		Type	Description
StatusDigitalOutputs		BYTE	Status word of all inputs
	StatusDigitalOutput00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
	...		
	StatusDigitalOutput15 (1)		
(1) The number of digital inputs bit is equal to the module input number.			

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SDO4TA and TM5SDO8TA

Introduction

The TM5SDO4TA and TM5SDO8TA expansion electronic modules are 24 Vdc Digital Output electronic modules with 4 and 8 outputs respectively.

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SDO4TA	TM5SDO4TA Electronic Module 4DO 24 Vdc Tr 2 A 3 Wires (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDO8TA	TM5SDO8TA Electronic Module 8DO 24 Vdc Tr 2 A 1 Wire (see Modicon TM5, Digital I/O Modules, Hardware Guide)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 48, for the output parameters configuration details.
- Status Mapping, page 49, for the status bits configuration details.
- Input Mapping, page 49, for the input parameters configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Output Mapping

This table describes the TM5SDO4TA and TM5SDO8TA output mapping configuration:

Channel		Type	Description
DigitalOutputs		BYTE	Command word of all outputs
	DigitalOutput00	BOOL	Command bit of output 0
	...		...
	DigitalOutput07 (1)		Command bit of output 7
(1) The number of digital outputs bit is equal to the module output number.			

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDO4TA and TM5SDO8TA status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping

This table describes the TM5SDO4TA and TM5SDO8TA input mapping configuration:

Channel		Type	Description
StatusDigitalOutputs		BYTE	Status word of all inputs
	StatusDigitalOutput00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
	...		
	StatusDigitalOutput07 (1)		
PowerSupply		BYTE	Status of power supply
	reserved	BOOL	Not used
	reserved	BOOL	Not used
	PowerSupply00	BOOL	Power supply status (0 = DC OK)
(1) The number of digital inputs bit is equal to the module input number.			

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SDO2R and TM5SDO4R

Introduction

The TM5SDO2R and TM5SDO4R expansion electronic modules are 30 Vdc Digital Outputs electronic modules with 2 and 4 outputs respectively.

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SDO2R	TM5SDO2R Electronic Module 2DO 30 Vdc/230 Vac 5A Relay C/O (see Modicon TM5, Digital I/O Modules, Hardware Guide)
TM5SDO4R	TM5SDO4R Electronic Module 4DO 30 Vdc / 230 Vac 5 A Relay N/O (see Modicon TM5, Digital I/O Modules, Hardware Guide)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 50, for the output parameters configuration details.
- Input Mapping, page 50, for the input parameters configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Output Mapping

This table describes the TM5SDO2R and TM5SDO4R output mapping configuration:

Channel		Type	Description
Outputs		BYTE	Command word of all outputs
	DigitalOutput00	BOOL	Command bit of output 0
	...		...
	DigitalOutput03(1)		Command bit of output 3
(1) The number of digital outputs bit is equal to the module output number.			

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

Input Mapping

This table describes the TM5SDO2R and TM5SDO4R input mapping configuration:

Channel	Type	Description
Inputs	BYTE	Status word of all Inputs
DcOk	BOOL	Voltage range: • 0 = Invalid • 1 = Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0 = Bus error • 1 = Ok
I/O Data valid	BOOL	Data validity: • 0 = Valid • 1 = Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SDO2S

Introduction

The TM5SDO2S expansion electronic module is a 240 Vac Digital Outputs electronic module with 2 outputs.

For further information, refer to TM5SDO2S Electronic Module 2DO 240 Vac 1 A 3 wires (see Modicon TM5, Digital I/O Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 51, for the output parameters configuration details.
- Status Mapping, page 52, for the status bits configuration details.
- Input Mapping, page 52, for the input parameters configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Output Mapping

This table describes the TM5SDO2S output mapping configuration:

Channel		Type	Description
Outputs		BYTE	Command word of all outputs
	DigitalOutput00	BOOL	Command bit of output 0
	DigitalOutput01	BOOL	Command bit of output 1

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDO2S status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping

This table describes the TM5SDO2S input mapping configuration:

Channel		Type	Description
Zero crossover status		BYTE	Status word of all inputs
	StatusDigitalOutput00	BOOL	Status of digital output 0 (0 = OK)
	StatusDigitalOutput01	BOOL	Status of digital output 1 (0 = OK)

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SDM12DT

Introduction

The TM5SDM12DT expansion electronic module is a 24 Vdc Digital Inputs electronic module with 8 inputs and 4 outputs.

For further information, refer to TM5SDM12DT Electronic Module 8DI/4DO Tr 1 Wire (see Modicon TM5, Digital I/O Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 53, for the output parameters configuration details.
- Status Mapping, page 53, for the status bits configuration details.
- Input Mapping, page 54, for the input parameters configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Output Mapping

This table describes the TM5SDM12DT output mapping configuration:

Channel		Type	Description
Outputs		BYTE	Command word of all outputs
	DigitalOutput00	BOOL	Command bit of output 0
	...		
	DigitalOutput03		Command bit of output 3

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SDM12DT status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved

Channel	Type	Description
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusDigitalOutputs		BYTE	Status of module
	StatusDigitalOutputs00	BOOL	Status digital output 00 (0 = Ok)
	StatusDigitalOutputs01	BOOL	Status digital output 01 (0 = Ok)
	StatusDigitalOutputs02	BOOL	Status digital output 02 (0 = Ok)
	StatusDigitalOutputs03	BOOL	Status digital output 03 (0 = Ok)

Input Mapping

This table describes the TM5SDM12DT input mapping configuration:

Channel		Type	Description
Inputs		BYTE	Status word of all inputs
	DigitalInput00	BOOL	Status of digital output 00 (0 = Ok)
	...		
	DigitalInput07		Status of digital output 07 (0 = Ok)

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SMM6D2L

Introduction

The TM5SMM6D2L expansion electronic modules is a mixed module with 4 digital inputs, 2 digital outputs, 1 analog input, and 1 analog output.

If you have wired your input for a voltage measurement, and you configure EcoStruxure Machine Expert for a current type of configuration, you may permanently damage the electronic module.

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

For further information, refer to TM5SMM6D2L Electronic Module 4DI/2DO 24Vdc Tr 0.5A / 1AI/1AO ±10V/0-20mA 12 Bits 1 Wire (see Modicon TM5, Digital I/O Modules, Hardware Guide).

Analog Inputs

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Input Cycle

The electronic module is equipped with a configurable Input cycle. Filtering is deactivated for shorter cycle times.

If the Input cycle is active, then the channels are scanned in millisecond cycles. The time offset between the channels is 200 µs. The conversion takes place asynchronously to the network cycle.

Limit Values

You can define 2 different types of limits:

- **Lower limit**
- **Upper limit**

The **Lower limit** value range is between -32768 and 32767. This value is applied on every channel of the module being configured.

NOTE: the **Lower limit** cannot be greater than the **Upper limit**.

Channel Configuration	Digital Value Behavior	Comments
± 10 V	-10 V = -32768 +10 V = +32767	If the **Lower limit** value is configured between -32768 and +32767, the digital value is limited to the **Lower limit** value.
0...20 mA	0 mA = 0 20 mA = +32767	If the **Lower limit** value is configured between -32768 and 0, the digital value is limited to 0. If the **Lower limit** value is configured between 0 and 32767, the digital value is limited to the **Lower limit** value.
4...20 mA	0 mA = -8192 4 mA = 0 20 mA = +32767	If the **Lower limit** is configured between -32768 and -8192, the digital value is limited to -8192. If the **Lower limit** is configured between -8192 and 32767, the digital value is limited to the **Lower limit** value.

The **Upper limit** value range is between -32768 and 32767. This value is applied on every channel of the module being configured.

NOTE: The **Upper limit** value cannot be less than the **Lower limit** value.

Channel Configuration	Digital Value Behavior	Comments
± 10 V	-10 V = -32768 +10 V = +32767	If the **Upper limit** value is configured between -32768 and +32767, the digital value is limited to the **Upper limit** value.
0...20 mA	0 mA = 0 20 mA = +32767	If the **Upper limit** value is configured between -32768 and 0, the digital value stays at 0; hence, set the **Upper limit** value to a positive value. If the **Upper limit** value is configured between 1 and +32767, the digital value is limited to the **Upper limit** value.
4...20 mA	0 mA = -8192 4 mA = 0 20 mA = +32767	If the **Upper limit** value is configured between -32768 and -8192, the digital value is limited to -8192. If the **Upper limit** value is configured between -8192 and 32767, the digital value is limited to the **Upper limit** value.

Filter Level

The input value is evaluated according to the filter level. An input ramp limitation can then be applied using this evaluation.

Formula for the evaluation of the input value:

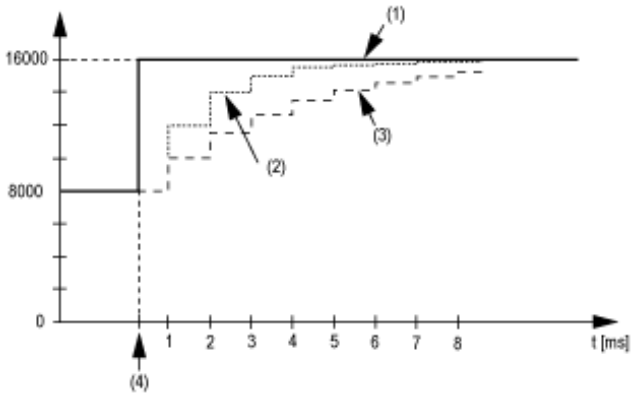
$$Value_{new} = Value_{old} - \frac{Value_{old}}{Filterlevel} + \frac{Inputvalue}{Filterlevel}$$

The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8000 to 16000. The diagram displays the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4



1 Input value.

2 Evaluated value: Filter level 2

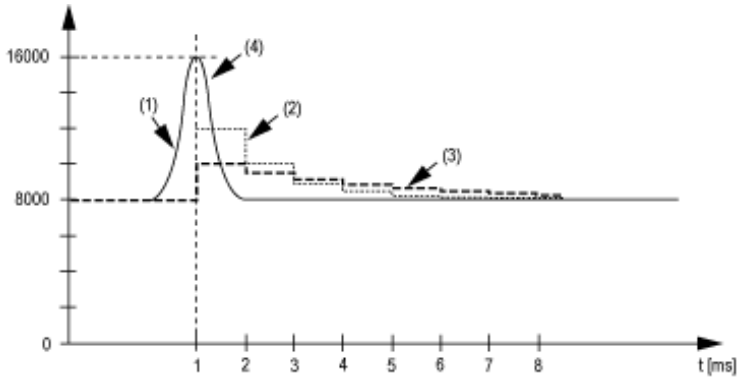
3 Evaluated value: Filter level 4

4 Input jump

Example 2: A disturbance is imposed on the input value. The diagram shows the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4



1 Input value

2 Evaluated value: Filter level 2

3 Evaluated value: Filter level 4

4 Disturbance (Spike)

Input Ramp Limitation

Input ramp limitation can only take place when a filter is used. Input ramp limitation is executed before filtering takes place.

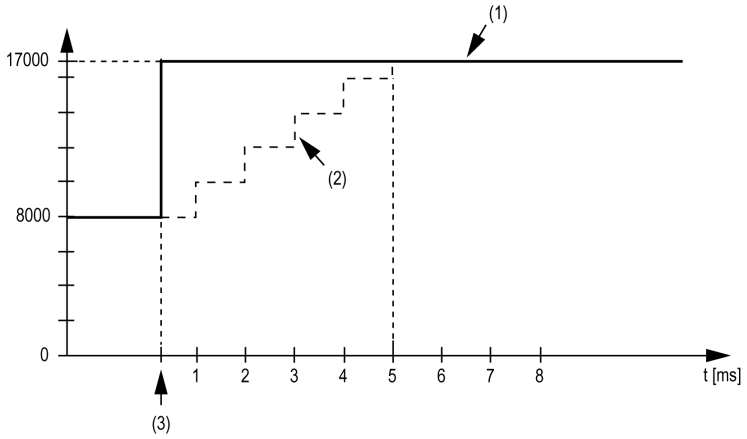
The change in the input value is verified to make sure that the specified limits are not exceeded. If the values are exceeded, the adjusted input value is equal to the previous value ± the limit value.

The input ramp limitation is well suited for suppressing disturbances (spikes). The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8,000 to 17,000. The diagram displays the adjusted input value for the following settings:

Input ramp limitation = 2047

Filter level = 2



1 Input value

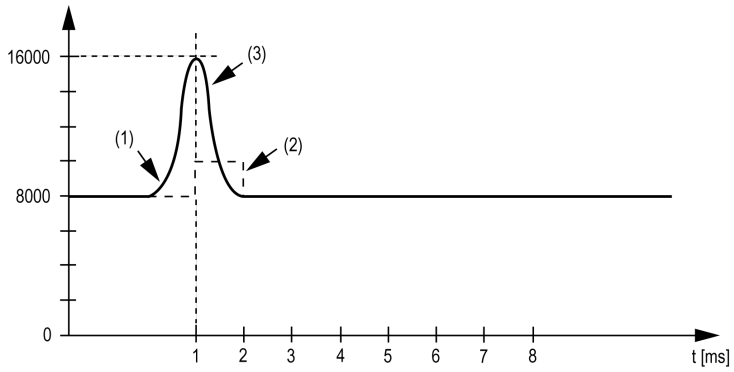
2 Internal adjusted input value before filter

3 Input jump

Example 2: A disturbance is imposed on the input value. The diagram shows the adjusted input value with the following settings:

Input ramp limitation = 2047

Filter level = 2



1 Input value

2 Internal adjusted input value before filter

3 Disturbance (Spike)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O Mapping:

Variable	Channel		Type	Description
Inputs	**Digital Inputs**		BYTE	State of all inputs.
		DigitalInput00	BOOL	State of input 0.
		...		...
		DigitalInput03	BOOL	State of input 3.
		StatusDigitalOut-put00	BOOL	Status bit associated to each output: • 0: OK • 1: error detected
		StatusDigitalOut-put01	BOOL	
		reserved	BOOL	reserved
		reserved	BOOL	reserved
	Analogue Input		INT	Value of the analog input.
		Bit0	BOOL	–
		...		...
		Bit15	BOOL	–
Outputs	**Reset Counter**		BYTE	Status of bits of reset counter.
		Configuration Bit 0	BOOL	Counter configuration.
		...		
		Configuration Bit 3	BOOL	Counter configuration.
	reserved		BOOL	reserved.
	ResetCounter 0		BOOL	Reset event counter 0; 1=reset.
	Mode Bit 0		BOOL	• 00: Event counter • 01: Gate measurement
	Mode Bit 1		BOOL	• 00: Event counter • 01: Gate measurement
	DigitalOutputs		BYTE	Command word of the outputs.
		DigitalOutput00	BOOL	Command bit of output 0.
		DigitalOutput01		Command bit of output 1.
	Analogue Output		INT	Value of the analog output.
		Bit0	BOOL	–
		...		...
		Bit15	BOOL	–

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SMM6D2L user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilterDI	0...127	10	Definition of the filter level, page 56.
InputFilterAI	off level 2 level 4 level 8 level 16 level 32 level 64 level 128	off	Definition of the filter level, page 56.
InputLimitationAI	off 16383 8191 4095 2047 1023 511 255	16383	Specifies the limitation of input ramp, page 57. **NOTE:** Parameter available if an input filter is selected.
ChannelType01AI	-10 V to +10 V 0 to 20 mA 4 to 20 mA	-10 V to +10 V	Specifies the channel type.
ChannelType01AO	-10 V to +10 V 0 to 20 mA	-10 V to +10 V	Specifies the channel type.
LowerLimitAI	-32768...32767	-32767	Specifies the lower measurement limit, page 55.
UpperLimitAI	-32768...32767	32767	Specifies the upper measurement limit, page 55.

TM5 Analog I/O Electronic Modules

Introduction

This chapter provides information to configure analog I/O expansion electronic modules.

To add expansion electronic modules and access to the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5SAI2H and TM5SAI4H

Introduction

The TM5SAI2H and TM5SAI4H expansion electronic modules are 10 Vdc Analog Input electronic modules with 2 and 4 inputs respectively.

If you have wired your input for a voltage measurement and you configure EcoStruxure Machine Expert for a current type of configuration, you may permanently damage the electronic module.

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

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SAI2H	TM5SAI2H Electronic Module 2AI ±10V/0-20mA 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)
TM5SAI4H	TM5SAI4H Electronic Module 4AI ±10V/0-20mA 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)

Limit Values

You can specify an upper and lower limit value for each individual channel.

When activated, the input signals are monitored to verify whether the limit values are exceeded. The defined limit values are used for this. If the analog value goes beyond the defined range, then it is limited to the upper or lower limit value.

The result of the signal check is displayed in a corresponding status bit. If necessary, the counters are incremented by one if the value falls outside the range.

Scaling

The raw A/D converter data and the filtered A/D converter data are compared. The system measure and your measure are grouped internally as a k/d pair to optimize the execution time. Gain and offset can be specified for each individual channel.

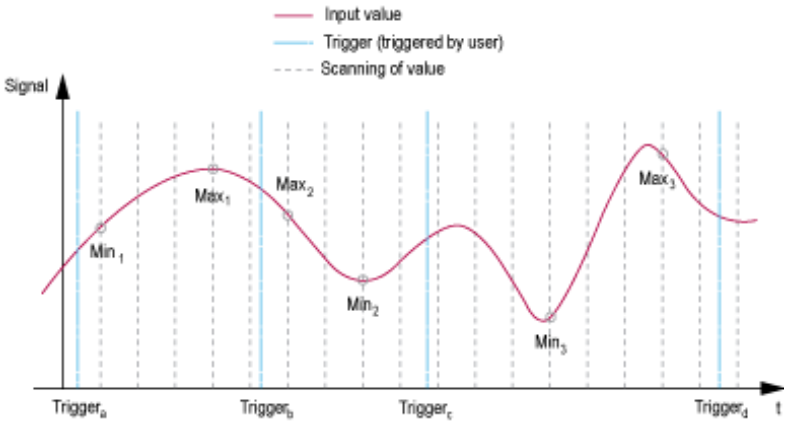
Minimum and Maximum Input Values

The system stores the minimum and maximum values between two trigger events. The function is started by the corresponding trigger edge. The following edges are evaluated depending on the configuration:

- Positive edge
- Negative edge
- Positive and negative edge

The trigger counter counts valid trigger events. In the event that trigger events occur faster than the sampling cycle, the triggering becomes invalid (trigger detected error counter is incremented).

The following example shows how the minimum and maximum input values are recorded:



Trigger Event	Description
Trigger a	The function is started. The system notes the minimum and maximum values of the input signal. Ignore the Min./Max values registered by the status bit after the initial start.
Trigger b	The minimum value (Min1) and the maximum value (Max1) between Trigger a and Trigger b are given to the register and the new cycle is started. A status bit informs you as soon as the values are valid.
Trigger c	The minimum value (Min2) and the maximum value (Max2) between Trigger b and Trigger c are given to the register and the new cycle is started. A status bit informs you as soon as the values are valid.
Trigger d	The minimum value (Min3) and the maximum value (Max3) between Trigger c and Trigger d are given to the register and the new cycle is started. A status bit informs you as soon as the values are valid.

Input Cycle

The electronic module has an Input cycle that can be configured separately for each individual channel. The order and cut-off frequency can be specified for each individual channel:

- Filter Order: 1...4 (default: 1)
- Filter Cut-off frequency: 1...65535 Hz (default: 500 Hz)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status	**Status**	BYTE	State of all inputs
	Status Analog Input 01	BOOL	Status of analog inputs: • 0: Ok. • 1: Error
	...		...
	Status Analog Input 04		Status of analog inputs: • 0: Ok. • 1: Error
	reserved		reserved
	reserved		reserved
	synchronisation TM5 to conversion cycle		Synchronisation TM5 to conversion cycle: • 0: Synchronisation ok • 1: Synchronisation error
	Conversion Cycle		Status conversion cycle: • 0: Ok • 1: Error
Inputs	**AnalogInput00**	INT	Value of input 0
	...		...
	AnalogInput03		Value of input 3

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SAI2H and TM5SAI4H user-defined parameters configuration:

Name	Value	Default Value	Description
ChannelFilter01	off on	off	Enables/disables the channel filter.
MinMaxCheck01	off positive	off	Activates the minimum and maximum channel values, page 61.
ChannelErrCheck01	off on	on	Detects an error on the channel.
ChannelType01	-10 V to +10 V 0 to 20 mA	-10 V to +10 V	Specifies the channel type.
MinLimit01	-32768...32767	-32767	Limitation minimum value, page 60.
MaxLimit01	-32768...32767	32767	Limitation maximum value, page 60.
UserGain01	-2,147,483,648...2,147,483,647	65536	The user-defined gain for the A/D converter data of the respective physical channel can be specified in these registers. The value 65536 (10000 hex) corresponds to a gain of 1.
Useroffset01	-2,147,483,648...2,147,483,647	0	The user-defined offset for the A/D converter data of the respective physical channel can be specified in this register. The value 65536 (10000 hex) corresponds to an offset of 1.
FilterOrder01	1...4	1	Filter order selection.
FilterConstant01	1...65535	500	Cutoff frequency in Hertz.
...			
ChannelFilter04	off on	off	Enables/disables the channel filter.
ChannelErrCheck04	off on	on	Detects an error on the channel.
ChannelType04	-10 V to +10 V 0 to 20 mA	-10 V to +10 V	Specifies the channel type.
MinLimit04	-32768...32767	-32767	Limitation minimum value, page 60.
MaxLimit04	-32768...32767	32767	Limitation maximum value, page 60.
UserGain04	-2,147,483,648...2,147,483,647	65536	The user-defined gain for the A/D converter data of the respective physical channel can be specified in these registers. The value 65536 (10000 hex) corresponds to a gain of 1.
Useroffset04	-2,147,483,648...2,147,483,647	0	The user-defined offset for the A/D converter data of the respective physical channel can be specified in this register. The value 65536 (10000 hex) corresponds to an offset of 1.
FilterOrder04	1...4	1	Filter order selection.
FilterConstant04	1...65535	500	Cutoff frequency in Hertz.
SampleTime	50...10000	100	The sampling time is set to µs in this register. This makes it possible to improve the sampling cycle (resolution = 1 µs). The lowest configurable cycle time is 50 µs.

TM5SAI2L and TM5SAI4L

Introduction

The TM5SAI2L and TM5SAI4L expansion electronic modules are 10 Vdc Analog Input electronic modules with 2 and 4 inputs respectively.

If you have wired your input for a voltage measurement, and you configure EcoStruxure Machine Expert for a current type of configuration, you may permanently damage the electronic module.

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

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SAI2L	TM5SAI2L Electronic Module 2AI ±10V/0-20mA/4-20mA 12 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)
TM5SAI4L	TM5SAI4L Electronic Module 4AI ±10V/0-20mA/4-20mA 12 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)

Analog Inputs

The input status is registered with a fixed offset with respect to the network cycle and is transferred in the same cycle.

Input Cycle

The electronic module is equipped with a configurable Input cycle. Filtering is deactivated for shorter cycle times.

If the Input cycle is active, then the channels are scanned in ms cycles. The time offset between the channels is 200 µs. The conversion takes place asynchronously to the network cycle.

Limit values

You can define 2 different type of limits:

- **Lower limit**
- **Upper limit**

The **Lower limit** value range is between -32768 to 32767. This value is applied on every channel of the module being configured.

NOTE: the **Lower limit** cannot be greater than the **Upper limit**.

Channel Configuration	Digital Value Behavior	Comments
± 10V	-10 V = -32768 +10 V = +32767	If the **Lower limit** value is configured between -32768 and +32767, the digital value is limited to the **Lower limit** value.
0...20 mA	0 mA = 0 20 mA = +32767	If the **Lower limit** value is configured between -32768 and 0, the digital value is limited to 0. If the **Lower limit** value is configured between 0 and 32 767, the digital value is limited to the **Lower limit** value.
4...20 mA	0 mA = -8192 4 mA = 0 20 mA = +32767	If the **Lower limit** is configured between -32768 and -8192, the digital value is limited to -8192. If the **Lower limit** is configured between -8192 and 32767, the digital value is limited to the **Lower limit** value.

The **Upper limit** value range is between -32768 to 32767. This value is applied on every channel of the module being configured.

NOTE: The **Upper limit** value cannot be less than the **Lower limit** value.

Channel Configuration	Digital Value Behavior	Comments
± 10V	-10 V = -32768 +10 V = +32767	If the **Upper limit** value is configured between -32768 and +32767, the digital value is limited to the **Upper limit** value.
0...20 mA	0 mA = 0 20 mA = +32767	If the **Upper limit** value is configured between -32768 and 0, the digital value stays at 0; hence, set the **Upper limit** value to a positive value. If the **Upper limit** value is configured between 1 and +32767, the digital value is limited to the **Upper limit** value.
4...20 mA	0 mA = -8192 4 mA = 0 20 mA = +32767	If the **Upper limit** value is configured between -32768 and -8192, the digital value is limited to -8192. If the **Upper limit** value is configured between -8192 and 32767, the digital value is limited to the **Upper limit** value.

Filter Level

The input value is evaluated according to the filter level. An input ramp limitation can then be applied using this evaluation.

Formula for the evaluation of the input value:

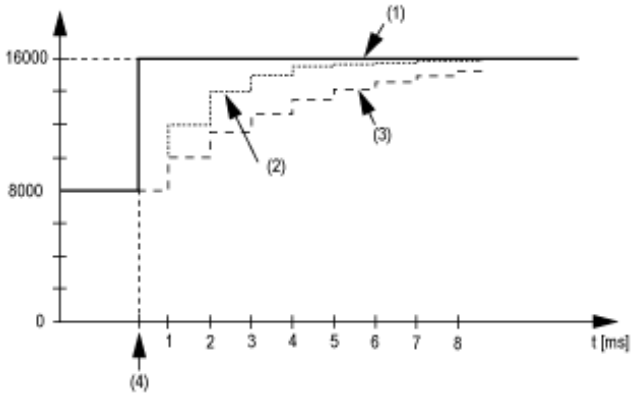
$$Value_{new} = Value_{old} - \frac{Value_{old}}{Filterlevel} + \frac{Inputvalue}{Filterlevel}$$

The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8000 to 16000. The diagram displays the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4



1 Input value.

2 Evaluated value: Filter level 2

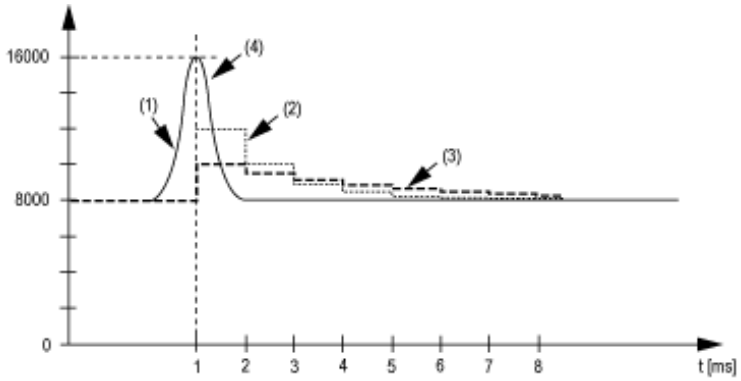
3 Evaluated value: Filter level 4

4 Input jump

Example 2: A disturbance is imposed on the input value. The diagram shows the evaluated value with the following settings:

Input ramp limitation = 0

Filter level = 2 or 4



1 Input value

2 Evaluated value: Filter level 2

3 Evaluated value: Filter level 4

4 Disturbance (Spike)

Input Ramp Limitation

Input ramp limitation can only take place when a filter is used. Input ramp limitation is executed before filtering takes place.

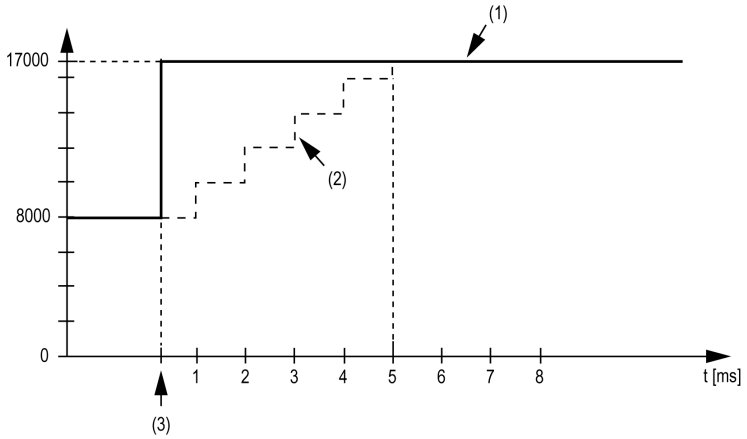
The amount of the change in the input value is verified to make sure the specified limits are not exceeded. If the values are exceeded, the adjusted input value is equal to the previous value ± the limit value.

The input ramp limitation is well suited for suppressing disturbances (spikes). The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1: The input value makes a jump from 8,000 to 17,000. The diagram displays the adjusted input value for the following settings:

Input ramp limitation = 2047

Filter level = 2



1 Input value

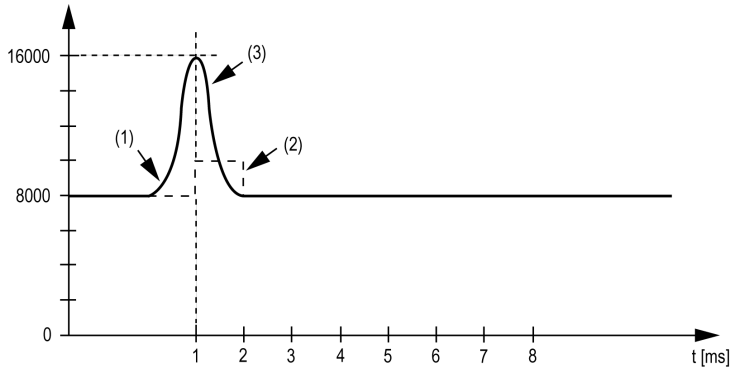
2 Internal adjusted input value before filter

3 Input jump

Example 2: A disturbance is imposed on the input value. The diagram shows the adjusted input value with the following settings:

Input ramp limitation = 2047

Filter level = 2



1 Input value

2 Internal adjusted input value before filter

3 Disturbance (Spike)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK

Channel	Type	Description
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

-	**StatusInput00**	BYTE	Status of analog input channels (see description below)
Inputs	**AnalogInput00**	INT	Value of the input 0
	...		...
	AnalogInput03		Value of the input 3

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Status Input Register

The **StatusInput00** byte describes the status of each input channel:

Bit	Description	Bits value
0-1	Channel 00 status	00: No error detected
2-3	Channel 01 status	01: Below lower limit value[1]
4-5	Channel 02 status	10: Above upper limit value
6-7	Channel 03 status	11: Wire break[2]

[1] Channel Configuration 4...20 mA

[2] Channel Configuration ± 10V

Default setting: The input value has a lower limit. Underflow monitoring is, therefore, not necessary.

After lower limit value changes: The input value is limited to the set value. The status bit is set when the lower limit value is passed.

NOTE: The bit dedicated to channel 2 and channel 3 are not used (bit=0) for the TM5SAI2L.

User-Defined Parameters Tab

This table describes the TM5SAI2L and TM5SAI4L user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilter	off level 2 level 4 level 8 level 16 level 32 level 64 level 128	off	Specifies the filter time of all digital inputs
InputLimitation	16383 off 4095 511 8191 1023 2047 255	16383	Defines the input ramp limitation of the input filter.
ChannelType01	-10 V to +10 V 0 to 20 mA 4 to 20 mA	-10 V to +10 V	Specifies the channel type.
ChannelType02	-10 V to +10 V 0 to 20 mA 4 to 20 mA	-10 V to +10 V	Specifies the channel type.
ChannelType03(1)	-10 V to +10 V 0 to 20 mA 4 to 20 mA	-10 V to +10 V	Specifies the channel type.
ChannelType04(1)	-10 V to +10 V 0 to 20 mA 4 to 20 mA	-10 V to +10 V	Specifies the channel type.
LowerLimit	-32767	-32767	Specifies the lower measurement limit, page 64.
UpperLimit	32767	32767	Specifies the upper measurement limit, page 64.
(1) For TM5SAI4L.			

TM5SAI2PH and TM5SAI4PH

Introduction

The TM5SAI2PH and TM5SAI4PH expansion electronic modules are Analog Resistor Temperature electronic modules with 2 and 4 inputs respectively.

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

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SAI2PH	TM5SAI2PH Electronic Module 2AI PT100/PT1000 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)
TM5SAI4PH	TM5SAI4PH Electronic Module 4AI PT100/PT1000 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)

Analog Inputs

The converted analog values are output by the electronic module in the registers. Different resistance or temperature measurements result in different value ranges and data types.

Timing Setting

The timing setting for data acquisition is made using the converter hardware. All activated inputs are converted during each conversion cycle.

Conversion Time

The conversion time for the channels depends on their use. For the formulas listed in the table, 'n' corresponds to the number of channels that are agitated.

Channel Uses	Conversion Time
1 channel	1 x Input Filter time
n channels with the same sensor type	n x (Input Filter time + 20 ms)
n channels with different sensor types	n x (2 x Input Filter time + 20 ms)

Reduce Conversion Time

If an input is not necessary, it can be deactivated by setting the sensor type to Off, thereby reducing the refresh time.

The time saved is: Timesaving = 2 x 20 ms + Input Filter time

The Input Filter time is the conversion time for the remaining channels.

Sensor Type and Channel Deactivation

The electronic module is designed for temperature and resistance measurement. The sensor type must be specified because of the different adjustment values for temperature and resistance. To save time, individual channels can be deactivated by setting the sensor type to Off.

This table shows the sensor types:

Sensor Types	Digital Value	Temperature °C (°F)	Resolution
Sensor type PT100	-2000...8500	-200...850 (-328...1562)	0.1°C(0.18°F)
Sensor type PT1000	-2000...8500	-200...850 (-328...1562)	0.1°C (0.18°F)
Resistance measurement 0.1...4500 Ohm	1...45000	–	0.1 Ohm
Resistance measurement 0.05...2250 Ohm	1...45000	–	0.05 Ohm

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

-	**StatusInput00**	BYTE	Status of analog input channels (see description below)
Inputs	**Temperature00**	INT	Value of the input 0
	...		...
	Temperature03		Value of the input 3

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

NOTE: The bytes dedicated to channel 2 and channel 3 are not available for the TM5SAI2PH.

Status Input Register

The **Status Input00** byte describes the status of each input channel:

Bit	Type	Description
0-3	BOOL	00: No error detected 01: Below lower limit value 10: Above upper limit value 11: Wire break
4-7	BOOL	reserved

Limit Analog Value

In addition to the status information, the analog value is set to the values listed below, by default, when an error is detected. The analog value is limited to the new values if the limit values were changed.

Detected ErrorType	Temperature Measurement Digital Value for Detected Error	Resistance Measurement Digital Value for Detected Error
Wire break	+32767 (7FFF hex)	65535 (FFFF hex)
Above upper limit value	+32767 (7FFF hex)	65535 (FFFF hex)
Below lower limit value	-32767 (8001 hex)	0 (0 hex)
Invalid value	-32768 (8000 hex)	65535 (FFFF hex)

User-Defined Parameters Tab

This table describes the TM5SAI2PH and TM5SAI4PH user-defined parameters configuration:

Name	Value	Default Value	Description
ConnectionType	3 wire connection 2 wire connection	3 wire connection	Specifies 3 wire connection or 2 wire connection.
InputFilter	66.7 ms 40 ms 33.3 ms 20 ms 16.7 ms 10 ms 2 ms 1 ms	66.7 ms	Specifies the filter time on the module.
SensorType01	PT100 PT1000 0.1 Ohm to 4500.0 ohm 0.05 Ohm to 2250.0 Ohm off	PT100	Specifies the sensor type, page 71. **Off**: the **Temperature00** channel is removed from the **I/O Mapping** tab.

Name	Value	Default Value	Description
SensorType02	PT100 PT1000 0.1 Ohm to 4500.0 ohm 0.05 Ohm to 2250.0 Ohm off	PT100	Specifies the sensor type, page 71. **Off**: the **Temperature01** channel is removed from the **I/O Mapping** tab.
SensorType03(1)	PT100 PT1000 0.1 Ohm to 4500.0 ohm 0.05 Ohm to 2250.0 Ohm off	PT100	Specifies the sensor type, page 71. **Off**: the **Temperature02** channel is removed from the **I/O Mapping** tab.
SensorType04(1)	PT100 PT1000 0.1 Ohm to 4500.0 ohm 0.05 Ohm to 2250.0 Ohm off	PT100	Specifies the sensor type, page 71. **Off**: the **Temperature03** channel is removed from the **I/O Mapping** tab.
(1) For TM5SAI4PH			

TM5SAI2TH and TM5SAI6TH

Introduction

The TM5SAI2TH and TM5SAI6TH expansion electronic modules are Analog Temperature Sensor with 2 and 6 Inputs respectively.

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

For further information, refer to the Hardware Guide:

Reference	Refer to
TM5SAI2TH	TM5SAI2TH Electronic Module 2AI Thermocouple J/K/N/S 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)
TM5SAI6TH	TM5SAI6TH Electronic Module 6AI Thermocouple J/K/N/S 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)

Analog Inputs

The converted analog values are output by the electronic module in the registers. The sensor type configured affects the value ranges.

Raw Value Measurement

If a sensor type other than J, K, N, or S is used, the terminal temperature must be measured on at least one input. Based on this value, you must perform a terminal temperature compensation.

Timing Setting

The timing setting for data acquisition is made using the converter hardware. All switched on inputs are converted during each conversion cycle. A terminal temperature measurement also takes place.

If an input is not necessary, it can be deactivated by setting the channel to Off, thereby reducing the refresh time. The measurement of the terminal temperature is deactivated.

Conversion Time

The conversion time depends on the number of channels used. For the formulas listed in the table, 'n' corresponds to the number of channels that are activated.

Channel Uses	Conversion Time
n channels	(n x (2 x Input Filter time + 200 µs)
1 channel	Corresponds to the Input Filter time

Terminal Temperature (Cold Junction) Compensation

General information

When using thermocouples, it is necessary to measure the temperature at the terminal connections of the TM5SAIxTH in order to calculate an accurate absolute temperature at the measuring point of the thermocouple.

NOTE: At least one terminal temperature sensor is required to determine the temperature measured by the connected thermocouples. Otherwise, a value of 7FFF hex is calculated for all the connected thermocouples.

The accuracy of the temperature measurement of the connected thermocouples is a function of the number of terminal temperature sensors connected to the block.

A terminal temperature compensation junction is useful for the following applications:

- When there is a large distance between the controller and point of measurement.
- To increase precision.

Bridging large distances

When there is a large distance between the controller and the point of measurement, use a terminal temperature compensation junction. The thermocouple voltage is supplied via copper cable from the terminal temperature compensation junction to the terminal on the TM5SAIxTH. The temperature measured at the terminal temperature compensation junction is stored in the I/O area of the TM5SAIxTH electronic module. The TM5SAIxTH electronic module calculates the thermocouple temperature internally from the measured voltage and the reference junction temperature value (per channel).

Increased precision

To increase the precision, use a terminal temperature compensation junction. The construction of the terminal temperature compensation junction is the same as

described above. The installation of a terminal temperature compensation junction is especially helpful in the following cases:

- There is a slice next to the TM5SAIxTH that requires more than 1 W.
- There is no slice next to the TM5SAIxTH.
- With strongly fluctuating ambient conditions (draft, temperature).

NOTE: If the J, K, N and S types are used, you must select the external compensation.

Sensor Type and Channel Deactivation

The electronic module is designed for various sensor types. The sensor type must be specified because of the different adjustment values. The default setting for all channels is ON. To save time, individual channels can be deactivated.

This table shows the code corresponding sensor types:

Sensor Types
Sensor type J: -210...1200 °C (-346...2192 °F), digital value: -2100...12000
Sensor type K: -270...1372 °C (-454...2501 °F), digital value: -2700...13720
Sensor type N: -270...1300 °C (-454...2372 °F), digital value: -2700...13000
Sensor type S: -50...1768 °C (-58...3214 °F), digital value: -500...17680
Raw value without linearization and terminal temperature compensation. Resolution 1 µV for a measurement range of ±32.767 mV.
Raw value without linearization and terminal temperature compensation. Resolution 2 µV for a measurement range of ±65.534 mV.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	**Type**	**Description**
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

-	**StatusInput00**	BYTE	Status of analog input channels (see description below)
	StatusInput01	BYTE	Status of analog input channels (see description below)
Inputs	**Temperature00**	INT	Value of the input 0
	...		...
	Temperature05		Value of the input 5

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

NOTE: The channel 2...5 parameters are not available for the TM5SAI2TH.

User-Defined Parameters Tab

This table describes the TM5SAI2TH and TM5SAI6TH user-defined parameters configuration:

Name	Value	Default Value	Description
InputFilter	66.7 ms 40 ms 33.3 ms 20 ms 16.7 ms 10 ms 2 ms 1 ms	66.7 ms	Specifies the filter time on the module.
Environment	Standard lowpower midpower highpower	Standard	–
SensorType	J K N S 1 µV/bit 2 µV/bit B R	J	Specifies the sensor type, page 75.
DisableChannel01 ... **DisableChannel06**(1)	On Off	On	**On**: The channel is disabled. **NOTE:** Selectively disabling of unused channels reduces the electronic module cycle time.
(1) DisableChannel03...**DisableChannel06**: For TM5SAI6TH.			

TM5SAO2H and TM5SAO2L

Introduction

The TM5SAO2H and TM5SAO2L expansion electronic modules are analog output electronic modules with 2 outputs, ±10 Vdc / 0 to 20 mA.

If you have wired your output for a voltage measurement, and you configure EcoStruxure Machine Expert for a current type of configuration, you may permanently damage the electronic module.

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

For further information, refer to the Hardware Guide:

Reference	Refer To
TM5SAO2H	TM5SAO2H Electronic Module 2AO ±10V/0-20mA 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)
TM5SAO2L	TM5SAO2L Electronic Module 2AO ±10V/0-20mA 12 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Variable	Channel	Type	Description
Outputs	**AnalogOutput00**	INT	Command word of the output 0
	AnalogOutput01		Command word of the output 1

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SAO2H and TM5SAO2L user-defined parameters configuration:

Name	Value	Default Value	Description
ChannelType01	-10 V to +10 V 0...20 mA	-10 V to +10 V	Specifies the channel type.
ChannelType02	-10 V to +10 V 0...20 mA	-10 V to +10 V	Specifies the channel type.

TM5SAO4H and TM5SAO4L

Introduction

The TM5SAO4H and TM5SAO4L electronic modules are analog outputs electronic modules with 4 outputs, ±10 Vdc / 0 to 20 mA.

If you have wired your output for a voltage measurement, and you configure EcoStruxure Machine Expert a current type of configuration, you may permanently damage the electronic module.

NOTICE

INOPERABLE EQUIPMENT

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

Failure to follow these instructions can result in equipment damage.

For further information, refer to the Hardware Guide:

Reference	Refer To
TM5SAO4H	TM5SAO4H Electronic Module 4AO ±10V/0-20mA 16 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)
TM5SAO4L	TM5SAO4L Electronic Module 4AO ±10V/0-20mA 12 Bits (see Modicon TM5, Analog I/O Modules, Hardware Guide)

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid

Channel	Type	Description
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Outputs	**AnalogOutptu00**	INT	Command word of the output 0
	AnalogOutptu01		Command word of the output 1
	AnalogOutptu02		Command word of the output 2
	AnalogOutptu03		Command word of the output 3

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SAO4H and TM5SAO4L user-defined parameters configuration:

Name	Value	Default Value	Description
ChannelType01 ... **ChannelType04**	-10 V to +10 V 0...20 mA	-10 V to +10 V	Specifies the channel type.

TM5 Analog Strain Gauge Electronic Module

Overview

This chapter describes the configuration of the TM5SEAISG electronic module.

To add an expansion electronic module and to access the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5SEAISG

Introduction

The TM5SEAISG is an analog electronic module which allows to convert the output of a 4-wire or 6-wire full-bridge strain gauge to a numeric value.

For further information, refer to the TM5SEAISG Analog Strain Gauge Input Electronic Module (see Modicon TM5, Analog I/O Modules, Hardware Guide) and the TM5 IoDrvTM5SEAISG Strain Gauge Library Guide. (see Modicon TM5, Strain Gauge IoDrvTM5SEAISG, Library Guide)

Configuring a Strain Gauge Electronic Module

First Step

Add the TM5SEAISG module to your project.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer to the following paragraphs:

- Output Mapping, page 80, for the output parameters configuration details.
- Status Mapping, page 80 for the status bits configuration details
- Input Mapping, page 81, for the input parameters configuration details.

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

Output Mapping

This table describes the TM5SEAISG output mapping configuration:

Channel	Type	Description
ConfigOutput00	USINT	Commands the ADC configuration, page 82.

Status Bit Mapping

This table describes the TM5SEAISG status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Input Mapping Tab

This table describes the TM5SEAISG input mapping configuration:

Channel	Type	Description
StatusInput00	USINT	Status of analog input channel.
AnalogInput00	DINT	Value of the input 0. This is the raw value read by the TM5SEAISG. See Analog Input Register, page 81.

For further generic descriptions, refer to I/O Mapping Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SEAISG user-defined parameters configuration:

Name	Value	Default Value	Description
ADCCycletime	400	400	Specifies the cycle time for ADC (Analog/Digital Converter), adjustable in steps of 100 µs.

Analog Input Register

The **AnalogInput00** channel contains the raw value of the ADC for the full-bridge strain gauge with 24-bit resolution.

The table describes the **AnalogInput00** values:

Value	Description
FF80 0001...007F FFFF hex	Valid value
007F FFFF hex	Overflow
FF80 0001 hex	Underflow
FF80 0000 hex	Invalid value

ADC Configuration Register

The table describes the **ConfigOutput00** ADC configuration register:

Bit	Value	Description	Value
0-3	0000 hex	Data rate (samples per second):	2.5
	0001 hex		5
	0010 hex		10
	0011 hex		15
	0100 hex		25
	0101 hex		30
	0110 hex		50
	0111 hex		60
	1000 hex		100
	1001 hex		500
	1010 hex		1000
	1011 hex		2000
	1100 hex		3750
	1101 hex		7500
	1110 hex		Synchronous mode, page 82
	1111 hex		Reserved
4-6	000 hex	Bridge factor	16 mV/Vdc
	001 hex		8 mV/Vdc
	010 hex		4 mV/Vdc
	011 hex		2 mV/Vdc
	100 hex		256 mV/Vdc
	101 hex		128 mV/Vdc
	110 hex		64 mV/Vdc
	111 hex		32 mV/Vdc
7	0 hex	Reserved (must be 0)	0

Module Configuration

Description

The module has 2 functioning modes:

- Synchronous
- Asynchronous

Synchronous Mode

The ADC is synchronously read with the TM5 Bus when:

- The bits 0...3 of the ADC Configuration Register **ConfigOutput00** are set with the value 1110 hex.
- The ADC cycle time is ≥ 1/4 the TM5 Bus cycle time. For further information, refer to Analog Input Register, page 81.

- The ADC cycle time is a multiple integer of the configured cycle time of the TM5 Bus.

  NOTE: AnalogInput00 is set to FF80 0000 hex if the electronic module is configured with values outside these limits.

Asynchronous Mode

When the ADC is asynchronously read with the TM5 bus, the electronic module attempts to maintain to the set ADC cycle time as closely as possible without being synchronized to the TM5 Bus and the bit 2 of `StatusInput00` is set to 1 (see Status Input Register table, page 81).

The following table describes the jitter, down time and settling time:

Characteristics		**Values**
Jitter	ADC cycle times <1500 µs	± 1 µs maximum
	ADC cycle times >1500 µs	± 4 µs maximum
Down time on the TM5 Bus		50 µs + (TM5 Bus cycle time/128)
Settling time [1]		150 x TM5 Bus cycle time
[1] The settling time is the time between the falling edge of the valid bit (bit 0 in the status register) and the falling edge of the ADC synchronous bit (bit 2 in the status register).		

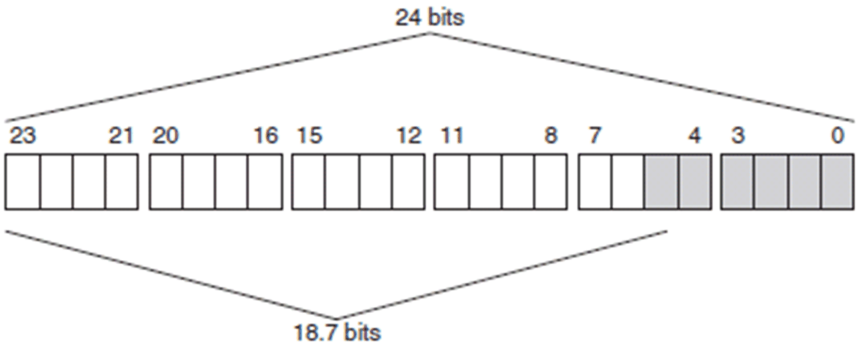
Effective Resolution

Overview

Through the Sigma-Delta conversion method of the analog signals on the TM5SEAISG, there is, in principal, an effective resolution of the displayed value.

If the ADC of the TM5SEAISG outputs a 24-bit value, the attainable resolution according to calculation is smaller than the 24-bit converter resolution. The effective resolution depends on the data rate and the bridge factor defined in the **ConfiguOutput00** ADC configuration register.

For example, a data rate of 2.5 Hz and a bridge factor of 2 mV/Vdc result in an effective resolution of 18.7 bits. Therefore, the amount of information in the low-order bits (marked in gray) is only natural in theory and is subject to heavy disturbances.



Strain Gauge Value

The **AnalogInput00** channel contains the raw value of the ADC for the full-bridge strain gauge with 24-bit resolution.

The tables below provides the effective resolution (in bits) of the full-bridge strain gauge value depending on the electronic module configuration (data rate, bridge factor). Refer to ADC Configuration Register, page 82.

	Bridge factor			
	± 16 mV/Vdc	**± 8 mV/Vdc**	**± 4 mV/Vdc**	**± 2 mV/Vdc**
Data rate (Hz)	**Bits**	**Bits**	**Bits**	**Bits**
2.5	21.3	20.8	19.7	18.7
5	20.7	20.3	19.3	18.3
10	20.4	19.9	18.9	17.9
15	20.1	19.3	18.7	17.7
25	19.7	19.2	18.5	17.5
30	19.6	19.0	18.1	17.1
50	19.4	18.8	17.9	16.9
60	19.3	18.8	17.8	16.8
100	19.1	18.5	17.4	16.4
500	18.0	17.3	16.3	15.3
1000	17.2	16.5	15.6	14.6
2000	16.6	16.1	15.3	14.3
3750	16.2	15.7	14.7	13.7
7500	15.8	15.3	14.4	13.4

	Bridge factor			
	± 256 mV/Vdc	**± 128 mV/Vdc**	**± 64 mV/Vdc**	**± 32 mV/Vdc**
Data rate (Hz)	**Bits**	**Bits**	**Bits**	**Bits**
2.5	23	22.6	22.1	21.7
5	22.3	22.4	21.9	21.3
10	22.3	22	21.6	21
15	22	21.7	21.3	20.7
25	21.8	21.4	21.1	20.5
30	21.7	21.3	20.8	20.4
50	21.3	21.1	20.5	19.9
60	21.3	20.9	20.4	19.8
100	20.9	20.7	20.2	19.6
500	20.1	19.6	19.1	18.6
1000	19	18.6	18.1	17.5
2000	18.5	18.1	17.8	17
3750	18.1	17.8	17.3	16.6
7500	17.7	17.3	16.9	16.2

TM5 Expert I/O Electronic Modules

Introduction

This chapter provides information to configure expert I/O expansion electronic modules.

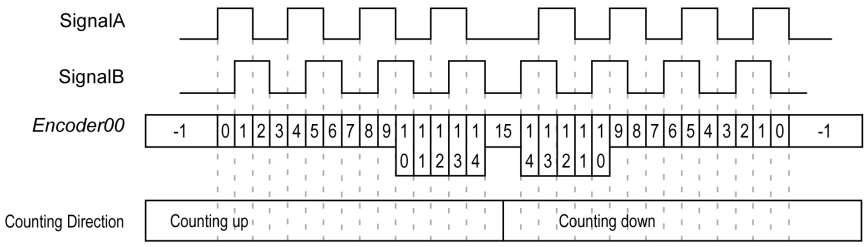
To add expansion electronic modules and access to the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5SE1IC02505

Introduction

The TM5SE1IC02505 expansion electronic module is a 5 Vdc or 24 Vdc Expert Inputs electronic module with 1 input channel for ABR incremental encoder.

The encoder signal is counted as shown below:



For further information, refer to TM5SE1IC02505 Electronic Module 1 HSC INC 250 kHz 5 Vdc (see Modicon TM5, Expert Modules (High Speed Counter) , Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

-	**PowerSupply**		BYTE	Status encoder supply
		PowerSupply01	BOOL	Status encoder supply 24 Vdc (0 = OK)
		PowerSupply02		Status encoder supply 5 Vdc (0 = OK)
Inputs	**Inputs**		BYTE	State of all digital inputs (bits 6...7: not used)
		SignalA	BOOL	Encoder Signal A
		SignalB	BOOL	Encoder Signal B
		SignalR	BOOL	Encoder Reference Impulse
		reserved	BOOL	reserved
		DigitalInput01	BOOL	State of digital input 0
		DigitalInput02	BOOL	State of digital input 1
		reserved	BOOL	reserved
		reserved	BOOL	reserved
-	**Encoder01**		DINT	Incremental encoder
-	**StatusInput01**		BYTE	Status incremental encoder 01 (see below)
-	**ReferenceModeEncoder01**		BYTE	Reference mode incremental encoder 01

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

StatusInput01 Register

This register contains information regarding whether the referencing process is off, active, or complete.

This table describes the **StatusInput01** register:

Bit	Description
0-1	Always 0
2	When the referencing is ON, this bit is 1 after the first reference impulse. When the referencing is OFF, this bit is 0.
3	When the referencing is ON, this bit toggles after each completed reference. When the referencing is OFF, this bit is 0.
4	This bit is 1 after the first reference impulse.
5...7	Free-running counter, increased with each reference impulse.

Example:

Register Value		Description
00000000 bin	00 hex	Referencing off or already in progress.
00111100 bin	3C hex	First reference complete, reference value applied in the **Encoder00** register.
xxx11100 bin	xB hex	Bits 5...7 are changed sequentially with each reference impulse.
xxx1x100 bin	xx hex	Bits changed continuously with the continuous referencing setting. With every reference impulse, the reference value is applied to the **Encoder00** register.

ReferenceModeEncoder01 Register

This register determines the encoder reference mode.

This table describes the **ReferenceModeEncoder01** register:

Bit	Value	Description
0-1	00	Referencing OFF
	01	One-time reference (single shot)
	11	Continuous referencing
2...5	0000	Bit permanently set = 0
6-7	00	Referencing OFF

Example:

Register Value		Description
00000000 bin	00 hex	Referencing OFF
11000001 bin	C1 hex	One-time reference (single shot). When starting over after the referencing process is complete, set this register to 00 hex. Then wait until the **StatusInput00** also takes on the value x0 hex.
11000011 bin	C3 hex	Continuous referencing: referencing occurs at every reference pulse.

User-Defined Parameters Tab

This table describes the TM5SE1IC02505 user-defined parameters configuration:

Name	Value	Default Value	Description
PresetABR01_32Bit	-2,147,483,648...2,147,483,647	0	Homing preset value for counter; the value set here is applied to the counter value upon completion of the referencing process.
ReferenceEdge	Off rising falling	Off	Selects edge of reference pulse for homing.
ReferenceEnableSwitch	low active high active	low active	Digital input 01 configure edge.
ReferenceEnableSwitch	disabled enabled	disabled	Enables/Disables the above parameter

TM5SE1IC01024

Introduction

The TM5SE1IC01024 expansion electronic module is a 24 Vdc Expert input electronic module with 1 input channel for ABR incremental encoder.

For further information, refer to TM5SE1IC01024 Electronic Module 1 HSC INC 100 kHz 24 Vdc (see Modicon TM5, Expert Modules (High Speed Counter) , Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

-	**PowerSupply**		BYTE	Status encoder supply
		PowerSupply00	BOOL	Status encoder supply (0 = OK)
Inputs	**Inputs**		BYTE	State of all digital inputs
		SignalA	BOOL	Encoder Signal A
		SignalB	BOOL	Encoder Signal B
		SignalR	BOOL	Encoder Signal R
		DigitalInput00	BOOL	State of digital input 0
	Encoder00		DINT	Incremental encoder
	StatusInput00		BYTE	Status incremental encoder 00 (see below)
-	**ReferenceModeEncoder00**		BYTE	Reference mode incremental encoder 00

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

StatusInput00 Register

This register contains information regarding whether the referencing process is off, active, or complete.

This table describes the **StatusInput00** register:

Bit	Description
0-1	Always 0
2	Bit is 1 after the first reference impulse
3	Toggle after each completed reference
4	Bit is 1 after the first reference impulse
5...7	Free-running counter, increased with each reference impulse

Example:

Register Value		Description
00000000 bin	00 hex	Referencing off or already in progress
00111100 bin	3C hex	First reference complete, reference value applied in the **Encoder00** register
xxx11100 bin	xB hex	Bits 5...7 are changed sequentially with each reference impulse
xxx1x100 bin	xx hex	Bits changed continuously with the setting continuous referencing. With every reference impulse, the reference value is applied to the **Encoder00** register.

ReferenceModeEncoder00 Register

This register determines the encoder reference mode.

This table describes the **ReferenceModeEncoder00** register:

Bit	Value	Description
0-1	00	Referencing OFF
	01	One-time reference (single shot)
	11	Continuous referencing
2...5	0000	Bit permanently set = 0
6-7	00	Referencing OFF

Example:

Register Value		Description
00000000 bin	00 hex	Referencing OFF
11000001 bin	C1 hex	One-time reference (single shot) When starting over after the referencing process is complete, set this register to 00 hex. Then wait until the **StatusInput00** also takes on the value 00 hex. Only then can the value C1 hex be written.
11000011 bin	C3 hex	Continuous referencing, referencing occurs at every reference pulse.

User-Defined Parameters Tab

This table describes the TM5SE1IC01024 user-defined parameters configuration:

Name	Value	Default Value	Description
PresetABR01_32Bit	-2,147,483,648...2,147,483,647	0	Homing preset value for counter; the value set here is applied to the counter value upon completion of the referencing process.
ReferenceEdge	Off rising falling	Off	Selects edge of reference pulse for homing.

Name	Value	Default Value	Description
ReferenceEnableSwitch	low active high active	low active	Digital input 01 configure edge.
ReferenceEnableSwitch	disabled enabled	disabled	Enables/Disables the above parameter.

TM5SE2IC01024

Introduction

The TM5SE2IC01024 expansion electronic module is a 24 Vdc Expert input electronic module with 2 input channels for ABR incremental encoder.

For further information, refer to TM5SE2IC01024 Electronic Module 2 HSC INC 100 kHz 24 Vdc (see Modicon TM5, Expert Modules (High Speed Counter) , Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

-	**PowerSupply**	BYTE	Status encoder supply (bits 1...7: not used)
	PowerSupply00	BOOL	Status encoder supply (0 = OK)
Inputs	**DigitalInput 0-7**	BYTE	State of all digital inputs
	SignalA	BOOL	Encoder Signal A
	SignalB	BOOL	Encoder Signal B
	SignalR	BOOL	Encoder Signal R
	DigitalInput00	BOOL	State of digital input 0
	SignalA	BOOL	Encoder Signal A
	SignalB	BOOL	Encoder Signal B
	SignalR	BOOL	Encoder Signal R
	DigitalInput01	BOOL	State of digital input 1
	Incremental encoder 00-01	-	Incremental encoder
	Encoder00	DINT	Incremental encoder
	Encoder01	INT	Incremental encoder
	Status incremental encoder 00-01		Status incremental encoder 00-01
	StatusInput00	BYTE	Status incremental encoder 00 (see below)
	StatusInput01	USINT	Status incremental encoder 01 (see below)
Outputs	**ReferenceModeEncoder00**	BYTE	Reference mode incremental encoder 00
	ReferenceModeEncoder01	BYTE	Reference mode incremental encoder 01

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

StatusInput0x Register

This register contains information regarding whether the referencing process is off, active, or complete.

This table describes the **StatusInput0x** register:

Bit	Description
0-1	Always 0
2	Bit is 1 after the first reference impulse
3	Toggle after each completed reference
4	Bit is 1 after the first reference impulse
5...7	Free-running counter, increased with each reference impulse

Example:

Register Value		Description
00000000 bin	00 hex	Referencing off or already in progress.
00111100 bin	3C hex	First reference complete, reference value applied in the **Encoder0x** register.
xxx11100 bin	xB hex	Bits 5...7 are changed sequentially with each reference impulse.
xxx1x100 bin	xx hex	Bits changed continuously with the setting continuous referencing. With every reference impulse, the reference value is applied to the **Encoder0x** register.

ReferenceModeEncoder0x Register

This register determines the encoder reference mode.

This table describes the **ReferenceModeEncoder0x** register:

Bit	Value	Description
0-1	00	Referencing OFF
	01	One-time reference (single shot)
	11	Continuous referencing
2...5	0000	Bit permanently set = 0
6-7	00	Referencing OFF

Example:

Register Value		Description
00000000 bin	00 hex	Referencing OFF
11000001 bin	C1 hex	One-time reference (single shot) When starting over after the referencing process is complete, set this register to 00 hex. Then wait until the **StatusInput0x** also takes on the value 00 hex. Only then can the value C1 hex be written.
11000011 bin	C3 hex	Continuous referencing, referencing occurs at every reference pulse.

User-Defined Parameters Tab

This table describes the TM5SE2IC01024 user-defined parameters configuration:

Name	Value	Default Value	Description
PresetABR01_32Bit	-2,147,483,648...2,147,483,647	0	Homing preset value for counter; the value set here is applied to the counter value upon completion of the referencing process.
ReferenceEdge01	Off rising falling	Off	Selects edge of reference pulse for homing.
ReferenceEnableSwitch01	low active high active	low active	Digital input 01 configure edge.
ReferenceEnableSwitch01	disabled enabled	disabled	Digital input 01 used as a reference enable switch.
PresetABR02_32Bit	-2,147,483,648...2,147,483,647	0	Homing preset value for counter; the value set here is applied to the counter value upon completion of the referencing process.
ReferenceEdge02	Off rising falling	Off	Selects edge of reference pulse for homing.

Name	Value	Default Value	Description
ReferenceEnableSwitch02	low active high active	low active	Digital input 01 configure edge.
ReferenceEnableSwitch02	disabled enabled	disabled	Enables/Disables the above parameter.

TM5SE1SC10005

Introduction

The TM5SE1SC10005 expansion electronic module is a 5 Vdc or 24 Vdc Expert Inputs electronic module with 1 input channel for SSI absolute encoder.

For further information, refer to TM5SE1SC10005 Electronic Module 1 HSC SSI 1 Mb 5 Vdc (see Modicon TM5, Expert Modules (High Speed Counter) , Hardware Guide).

Monoflop Check Parameter

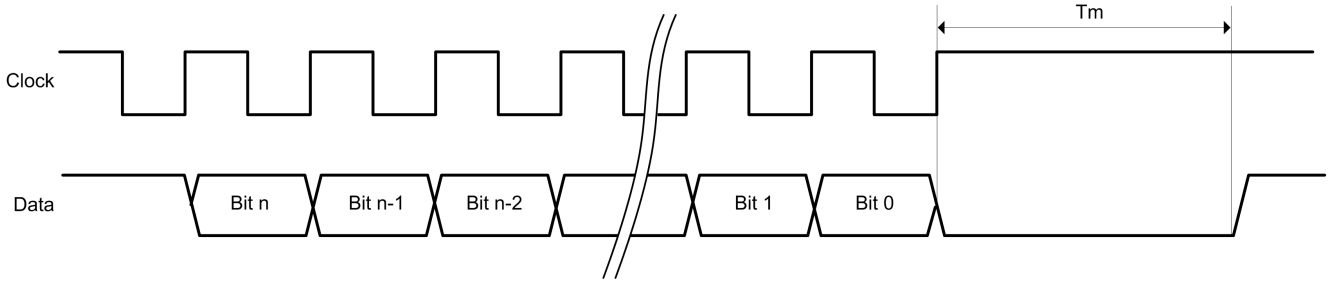
The **Monoflop check** parameter is used to test the data line level before starting data transmission: the clock starts only if the data line level is equal to the specified level.

This level is programmable, you can choose to perform the test or not.

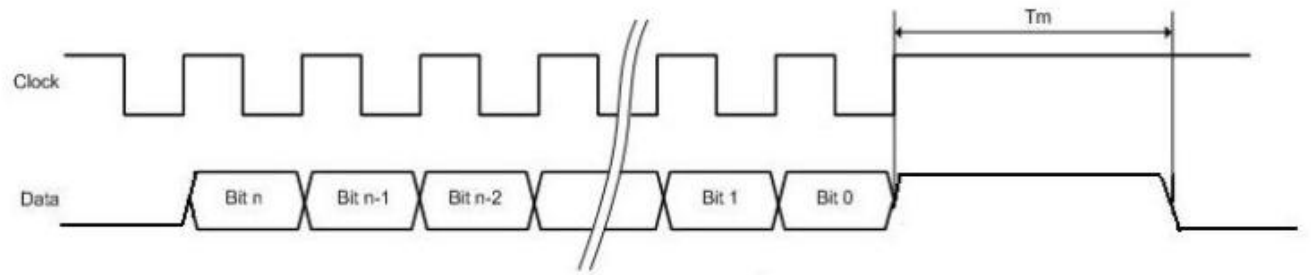
If you test the level, you can select its value (0 or 1) via the interface.

The data line level is verified from Tm after the last rising edge of the clock line

In the example 1, the **Monoflop check** parameter must be configured to high level so that the clock generation is postponed until the data line goes high.



In the example 2 the **Monoflop check** parameter must be configured to low level so that the clock generation is postponed until the data line goes low.



TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

This table describes the I/O mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

-	**PowerSupply**	BYTE	-	Status encoder supply (bits 2...7: not used)
	PowerSupply01	BOOL	-	Status encoder supply 24 Vdc (0 = OK)
	PowerSupply02	BOOL	-	Status encoder supply 5 Vdc (0 = OK)
Inputs	**Inputs**	BYTE	-	State of all digital inputs (bits 0...3, 6-7: not used)
	reserved	BOOL	-	Reserved
	...			
	reserved			
	DigitalInput01			State of digital input 0
	DigitalInput02			State of digital input 1
	Encoder01	DINT	-	Encoder position value

For further generic descriptions, refer to User-Defined Parameters Tab Description, page 15.

User-Defined Parameters Tab

This table describes the TM5SE1SC10005 user-defined parameters configuration:

Name	Value	Default Value	Description
DataFormat	binary gray	binary	Data format of SSI encoder.
Baudrate	1 MHz 500 kHz 250 kHz 125 kHz	1 MHz	Define the clock rate.
TotalBitLength	0...32	0	Number of bits sent by the SSI encoder per frame.
ValidBitLength	0...32	0	Significant part of the SSI encoder frame. Only the least significant part of the total SSI encoder frame is valid. The complementary most significant part of the frame is ignored and read as 0.
monoflopCheck	high level low level ignore	high level	Data line level is verified before starting data emission.

TM5 Transmitter - Receiver Electronic Modules

Introduction

This chapter provides information to configure transmitter - receiver expansion electronic modules.

To add expansion electronic modules and access to the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5SBET1

Introduction

The TM5SBET1 expansion electronic module is a Transmitter electronic module which transmits the TM5 data bus

For further information, refer to TM5SBET1 Transmitter Electronic Module (see Modicon TM5, Transmitter and Receiver Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 96, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SBET1 status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusInputs	BYTE	Status of the module
StatusInput00	BOOL	Bus power supply status: • 0 = OK • 1 = low voltage < 4.7 V
reserved		Not used (bit = 0)
StatusInput01		I/O power supply status: • 0 = OK • 1 = I/O power supply < 20.4 V

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SBET7

Introduction

The TM5SBET7 expansion electronic module is a Transmitter electronic module which transmits the TM7 data bus and provides the TM7 power bus to the TM7 expansion I/O blocks.

For further information, refer to TM5SBET7 Transmitter Electronic Module (see Modicon TM5, Transmitter and Receiver Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 97, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SBET7 status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved

Channel	Type	Description
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusInputs		BYTE	Status of the module
	StatusInput00	BOOL	Bus power supply status: • 0 = OK • 1 = low voltage < 18 V or current > 0.4 A
	reserved		Not used (bit = 0)
	StatusInput01		I/O power supply status: • 0 = OK • 1 = I/O power supply < 20.4 V

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SBER2

Introduction

The TM5SBER2 expansion electronic module is a Receiver electronic module which receives the TM5 data bus.

For further information, refer to TM5SBER2 Receiver Electronic Module (see Modicon TM5, Transmitter and Receiver Modules, Hardware Guide).

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 98, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SBER2 status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK

Channel	Type	Description
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusInputs		BYTE	Status of the module
	StatusInput00	BOOL	Bus power supply status: • 0 = OK • 1 = low voltage < 4.7 V or current > 2.3 A
	reserved		Not used (bit=0)
	StatusInput01		I/O power supply status: • 0 = OK • 1 = I/O power supply < 20.4 V

User-Defined Parameters Tab

There is no user configuration for this module.

TM5 Power Supply Electronic Modules

Introduction

This chapter provides information to configure power supply expansion electronic modules.

To add expansion electronic modules and access to the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5SPS1

Introduction

The TM5SPS1 expansion electronic module is a 24 Vdc power supply electronic module for internal I/O supply.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 100, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPS1 status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status		BYTE	Status of the module
	Bus power supply warning	BOOL	Bus power supply status: • 0 = OK • 1 = low voltage < 4.7 V

	reserved	BOOL	Not used (bit = 0)
	I/O power supply warning	BOOL	I/O power supply status: • 0 = OK • 1 = I/O power supply < 20.4 V

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SPS1F

Introduction

The TM5SPS1F expansion electronic module is a 24 Vdc power supply electronic module for internal I/O supply with a fuse.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 101, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPS1F status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status		BYTE	Status of the module
	Bus power supply warning	BOOL	Bus power supply status: • 0 = OK

			• 1 = low voltage < 4.7 V
	reserved	BOOL	Not used (bit = 0)
	I/O power supply warning	BOOL	I/O power supply status: • 0 = OK • 1 = I/O power supply < 20.4 V

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SPS2

Introduction

The TM5SPS2 expansion electronic module is a 24 Vdc power supply electronic module for internal I/O supply.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 102, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPS2 status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status	BYTE	Status of the module
Bus power supply warning	BOOL	Bus power supply status: • 0 = OK • 1 = low voltage < 4.7 V or current > 2.3 A
reserved	BOOL	Not used (bit = 0)
I/O power supply warning	BOOL	I/O power supply status: • 0 = OK • 1 = I/O power supply < 20.4 V

User-Defined Parameters Tab

There is no user configuration for this module.

TM5SPS2F

Introduction

The TM5SPS2F expansion electronic module is a 24 Vdc power supply electronic module for internal I/O supply with a fuse.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 103, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPS2F status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

Status		BYTE	Status of the module
	Bus power supply warning	BOOL	Bus power supply status: • 0 = OK • 1 = low voltage < 4.7 V or current > 2.3 A
	reserved	BOOL	Not used (bit = 0)
	I/O power supply warning	BOOL	I/O power supply status: • 0 = OK • 1 = I/O power supply < 20.4 V

User-Defined Parameters Tab

There is no user configuration for this module.

TM5 Common Distribution Electronic Modules

Introduction

This chapter provides information to configure common distribution expansion electronic modules.

To add expansion electronic modules and access to the configuration screens, refer to Adding an expansion electronic module, page 14.

TM5SPDG12F

Introduction

The TM5SPDG12F expansion electronic module is a 12 x Ground potential distribution electronic module with a fuse.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 105, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPDG12F status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusInputs		BYTE	Status of the module
	StatusFuse	BOOL	Fuse status: • 0 = OK • 1 = fuse is blown or missing

User-Defined Parameters

There is no user configuration for this module.

TM5SPDD12F

Introduction

The TM5SPDD12F expansion electronic module is a 12 x 24 Vdc potential distribution electronic module with a fuse.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 106, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPDD12F status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusInputs		BYTE	Status of the module
	StatusFuse	BOOL	Fuse status: • 0 = OK • 1 = fuse is blown or missing

User-Defined Parameters

There is no user configuration for this module.

TM5SPDG5D4F

Introduction

The TM5SPDG5D4F expansion electronic module is a 12 x 24 Vdc potential distribution electronic module with a fuse.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 107, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPDG5D4F status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusInputs		BYTE	Status of the module
	StatusFuse	BOOL	Fuse status: • 0 = OK • 1 = fuse is blown or missing
	StatusPowerSupply	BOOL	Power supply status (0 = DC OK)

User-Defined Parameters

There is no user configuration for this module.

TM5SPDG6D6F

Introduction

The TM5SPDG6D6F expansion electronic module is a 6 x Ground and 6 x 24 Vdc potential distribution electronic module with a fuse.

TM5 Module I/O Mapping Tab

Variables can be defined and named in the **TM5 Module I/O Mapping** tab. Additional information such as topological addressing is also provided in this tab.

Refer Status Mapping, page 108, for the status bits configuration details.

For further generic descriptions, refer to TM5 Module I/O Mapping Tab Description, page 15.

Status Bit Mapping

This table describes the TM5SPDG6D6F status bit mapping configuration:

Channel	Type	Description
ModuleOK	BYTE	State of the compact I/O and electronic modules
DcOk	BOOL	Voltage range: • 0: Invalid • 1: Valid
reserved	BOOL	Reserved
NetworkOk	BOOL	TM5 bus: • 0: Bus error • 1: OK
I/O Data valid	BOOL	Data validity: • 0: Valid • 1: Invalid
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved
reserved	BOOL	Reserved

StatusInputs		BYTE	Status of the module
	StatusFuse	BOOL	Fuse status: • 0 = OK • 1 = fuse is blown or missing
	StatusPowerSupply	BOOL	Power supply status (0 = DC OK)

User-Defined Parameters

There is no user configuration for this module.

TM5SD000

Introduction

The TM5SD000 expansion electronic module is a dummy electronic module.

User-Defined Parameters

There is no user configuration for this module.

TM5 Communication Module

Overview

This chapter provides information about the TM5SE1RS2 communication module.

Presentation

TM5SE1RS2 Communication Module

Description

The TM5SE1RS2 communication module is used to connect devices using RS232 communications.

This communication module can only be used with the TM5NS31 Sercos interface module.

Adding the TM5SE1RS2 Communication Module

Step	Action
1	In the **Devices tree**, drag and drop the Modicon LMC078 Motion Controller.
2	Drag and drop the TM5SE1RS2 on the **SERCOSIII (SERCOS III Interface)** node. **Result:** The TM5NS31 is automatically added with the TM5SE1RS2.

Description of TM5SE1RS2 Parameters

Double-click the **TM5SE1RS2 (TM5SE1RS2)** node. There are three tabs:

- SERCOS III Module I/O Mapping, page 110: Channels to configure.
- User Parameter, page 111: Parameters to configure.
- Information: Information about the TM5SE1RS2.

SERCOS III Module I/O Mapping Tab

The input and output channels of the module are mapped to project variables that are used by the application.

Channel	Meaning	Default value	Data type
OutputSequence, page 113	Transmitter sequence number Transmitter status Receiver sequence number acknowledgment Receiver status	–	BYTE
TxByte1–TxByte15, page 114	Control byte in sending direction or transmission data	–	BYTE

Channel	Meaning	Default value	Data type
InputSequence, page 115	Receiver sequence number Receiver status Transmitter sequence number acknowledgment Transmitter status	–	BYTE
RxByte1–RxByte15, page 116	Control byte in receiving direction or received data	–	BYTE

User Parameter Tab

The check box **Symbolic values** is used for switching between the numeric and the symbolic value.

Name	Meaning	Numeric/ symbolic value	Default value	Data type
Input MTU, page 117	Size of the maximum transmission unit (MTU), in bytes, available in the cyclic input data area	15 / 15 bytes	15 / 15 bytes	BYTE
Output MTU, page 117	Size of the MTU, in bytes, available in the cyclic output data area	15 / 15 bytes	15 / 15 bytes	BYTE
Block Forward, page 117	Maximum number of Input MTU blocks sent without acknowledgment from the module to the superordinate system	1 / 1	1 / Block Forward	BYTE
Block Forward Delay, page 118	Waiting time between Input MTU blocks sent without acknowledgment from the module to the superordinate system	0 / 0	0 / Block Forward Delay	BitArea
Multiple Segments, page 118	Multiple segments within MTU not permitted/ permitted	0 / off 1 / on	0 / off	BYTE
Segment Size, page 118	Segment size is maximum MTU size /segment size can exceed MTU size	0 / off 2 / on	0 / off	BYTE
Baudrate	Set baud rate	1200 / 1200 2400 / 2400 4800 / 4800 9600 / 9600 19200 / 19200 38400 / 38400 57600 / 57600 115200 / 115200	57600 / 57600	BitArea

Name	Meaning	Numeric/ symbolic value	Default value	Data type
Data Bits	Number of data bits	7 / 7 8 / 8	7 / 7	BYTE
Stop Bits	Number of stop bits	1 / 2 2 / 4	1 / 2	BYTE
Parity	Parity control bit	48 / Low 49 / High 69 / Even 78 / None 79 / Odd	69 / Even	BYTE
Upper Threshold, page 119	Upper threshold of the receiver FIFO	1024 / 1024	1024 / 1024	BitArea
Lower Threshold, page 119	Lower threshold of the receiver FIFO	512 / 512	512 / 512	BitArea
Receive Idle Time, page 119	Receive timeout	4 / 4	4 / Receive Idle Time	BitArea
Rx Frame Termination Char 1, page 120	Receive termination character 1	-1 / -1	-1 / Rx Frame Termination Char 1	BitArea
Rx Frame Termination Char 2	Receive termination character 2	-1 / -1	-1 / Rx Frame Termination Char 2	BitArea
Rx Frame Termination Char 3	Receive termination character 3	-1 / -1	-1 / Rx Frame Termination Char 3	BitArea
Rx Frame Termination Char 4	Receive termination character 4	-1 / -1	-1 / Rx Frame Termination Char 4	BitArea
Transmit Idle Time, page 119	Transmit timeout	5 / 5	5 / Transmit Idle Time	BitArea
Tx Frame Termination Char 1, page 120	Transmit termination character 1	-1 / -1	-1 / Tx Frame Termination Char 1	BitArea
Tx Frame Termination Char 2	Transmit termination character 2	-1 / -1	-1 / Tx Frame Termination Char 2	BitArea
Tx Frame Termination Char 3	Transmit termination character 3	-1 / -1	-1 / Tx Frame Termination Char 3	BitArea
Tx Frame Termination Char 4	Transmit termination character 4	-1 / -1	-1 / Tx Frame Termination Char 4	BitArea
RTS Inversion, page 120	Invert RTS (Request To Send) level	0 / off 16 / on	0 / Off	BYTE
CTS Inversion, page 120	Invert CTS (Clear To Send) level	0 / off 1 / on	0 / Off	BYTE
Hw Hand Shake Cts Recognition, page 120	Evaluation of the hardware handshake line CTS	0 / disabled 1 / flow control	0 / Disabled	BYTE

Name	Meaning	Numeric/ symbolic value	Default value	Data type
Hw Handshake Rts Mode, page 121	Operating mode of the output level of the hardware handshake line RTS, always on passive	16 / flow control	16 / Flow control	BYTE
Sw Handshake Xon Char, page 121	XON character ASCII code for flow control using software handshake	17 / 17	17 / Sw handshake Xon character -1 / Deactivated	BitArea
Sw Handshake Xoff Char, page 121	XOFF character ASCII code for flow control using software handshake	19 / 19	19 / Sw handshake XOff character -1 / Deactivated	BitArea
Sw Handshake Period, page 121	Automatic repeat time in milliseconds for sending the XON/ XOFF status character	0 / 0	0 / Software handshake period	BitArea

SERCOS III Module I/O Mapping Tab

Overview

This section provides information about the channels available in the **SERCOS III Module I/O Mapping** tab.

OutputSequence

General

Use this register to specify command information regarding sending and receiving readiness, the takeover of received data, and the number of frames to be sent to the module.

Bit	Description
0...2	0...7 = Consecutive transmitter sequence number
3	0 = Transmitter connection establishment requested by module 1 = Transmitter data exchange is enabled
4...6	0...7 = Receiver sequence number acknowledgment
7	0 = Receiver connection establishment requested by module 1 = Receiver data exchange is enabled

Consecutive Transmitter Sequence Number

If transmission data for the module are available, these are created in the *Output MTU* and the sequence number that is signaled to the module increased. A new sequence number with new data must only be placed in the *Output MTU* after the sequence number has been acknowledged as read by the *InputSequence* of the module. Here, an unacknowledged *Block Forward* of MTU blocks (this is how configuration is done in the input direction) is automatically possible. However, it is a requirement that each sequence can be read and evaluated by the module,

otherwise correct data transfer and sequence acknowledgment is not possible. This also applies for different cycle times of all involved components. The total number of blocks must not exceed 7, otherwise monitoring of the transmitter sequence number acknowledgment is not possible.

Transmitter Connection Establishment / Data Exchange

This bit provides status and command information to the module that the sending direction is active and synchronized. To send data from the module buffer, this bit must remain set to 1. Set this bit to 0 to disconnect the connection: frames in the transmit buffer that have already been transferred are still sent, while incomplete frames are discarded. To establish a new connection, synchronization must be repeated.

Receiver Sequence Number Acknowledgment

This field indicates to the module which received sequence from the *InputSequence* has been taken over. The module is thereby informed that the *Input MTU* has been “read out” and that the module can now overwrite it with new received data. This sequence must also be followed with an activated *Block Forward*.

Receiver Connection Establishment / Data Exchange

This bit provides status and command information to the module that the receiving direction is active and synchronized. If receiving data from the superordinate system, this bit must remain set to 1. Set this bit to 0 to disconnect the connection: data bytes still in the receive buffer and not yet transferred are deleted. To establish a new connection, synchronization must be repeated.

TxByte1 – TxByte15

General

These registers, collectively referred to as the *Output MTU* block, are used to transfer data to the module.

Control Byte in Sending Direction

This byte contains the information required to reassemble the sent frame from the individual *Output MTU* blocks and is send to the superordinate module.

Bit	Description
0...5	0...63 = Segment length
6	0 = Control byte for the next segment is in a new MTU (TxByte1) 1 = Control byte for the next segment follows immediately after the segment end
7	0 = Frame is not complete 1 = Frame is complete

Segment Length

Specifies the length of the segment to be sent. Only six bits are available in the control byte, therefore 63 is the maximum segment length. If the frame to be sent

is longer than the maximum segment length, it must be split into several segments with corresponding control bytes. The frame end is indicated to the module by setting bit 7 in the last segment.

Control Byte Position

Specifies the position of the control byte in the next segment.

Also see Multiple Segments / Segment Size, page 118.

Frame End Identifier

In the last segment, this bit is set as the frame end identifier. The complete frame is then released for sending.

InputSequence

General

This register is used by the module to indicate sending and receiving readiness, data received, and to send frame data to the superordinate system.

Bit	Description
0...2	0...7 = Consecutive receiver sequence number
3	0 = Receiver connection establishment requested by module 1 = Receiver data exchange is enabled
4...6	0...7 = Transmitter sequence number acknowledgment
7	0 = Transmitter connection establishment requested by module 1 = Transmitter data exchange is enabled

Consecutive Receiver Sequence Number

If data from the module are available, they are created in the *Input MTU* block and the sequence number sent to the superordinate system incremented. By default (see also *Block Forward*), a new sequence number with new data from the module is only put into the *Input MTU* block once the sequence number has been acknowledged by the *OutputSequence*. This is done to signal to the module that the *Input MTU* block has been read and can now be overwritten. This counter is also incremented to detect status changes in connection establishment or termination.

Receiver Connection Establishment / Data Exchange

With this status bit, the module signals whether the interface is ready to receive and is synchronized with the superordinate system. The interface is ready to receive only after synchronization (see also Synchronization of the Sending and Receiving Readiness, page 122).

This status bit should be regularly monitored, as if transfer errors are detected or noncompliance with the sequence acknowledgment, the module itself can disconnect the connection. If so, synchronization must be repeated.

Transmitter Sequence Number Acknowledgment

Indicates which sequence is to be sent from the *OutputSequence* the module received. The module thereby indicates that the data have been read from the *Output MTU* block and copied to the buffer. The *Output MTU* can therefore be overwritten with new transmission data.

Transmit Connection Establishment / Data Exchange

This bit is the status feedback from the module that the sending direction is active and synchronized (see also Synchronization of the Sending and Receiving Readiness, page 122). Therefore, data destined for the interface can now be sent.

RxByte1 – RxByte15

General

These registers, collectively referred to as the *Input MTU* block, are used to transfer data from the module to the superordinate system.

Control Byte in Receiving Direction

The module uses control bytes to transmit information to the superordinate system to enable it to reassemble the received frame from the individual *Input MTU* blocks and segments.

Bit	Description
0...5	0...63 = Segment length
6	0 = Control byte for the next segment is in a new MTU (RxByte1) 1 = Control byte for the next segment follows immediately after the segment end
7	0 = Frame is not complete 1 = Frame is complete

Segment Length

Specifies the length of the frame received. Only six bits are available in the control byte, therefore 63 is the maximum segment length. If the received frame is longer than the maximum segment length, it is split into several segments with corresponding control bytes. The frame end is detected by testing bit 7 in the last segment.

Control Byte Position

Indicates the position at which to expect the next control byte.

See also Multiple Segments/Segment Size, page 118.

Frame End Identifier

This bit is set in the last segment as the frame end identifier. The application can now further process the frame.

User Parameter Tab

Overview

This section provides information about the **User Parameter** tab.

Input MTU

General

This register configures the size of the MTU available in the input data area, in bytes. This MTU area is used to read the received data and the control bytes from the module. The MTU size is not related to the permitted segment size or the serial frame size; it just specifies the size of the transfer area on the bus.

The size of the input MTU is set to 15 bytes.

Output MTU

General

This register configures the number of bytes available in the cyclic output data area. This output MTU area is used to transfer data to be sent and control bytes to the module. The output MTU size is not related to the permitted segment size or the serial frame size; it just defines the size of the transfer area on the bus.

The size of the output MTU is set to 15 bytes.

Block Forward

General

This register specifies the maximum number of *Input MTU* blocks sent without acknowledgment from the module to the superordinate system.

Procedure with Default Setting = 1 (No Forwarding)

If the module considers a received frame as complete (frame size reached, frame end identifier set, and so on), the data exchange is acknowledged using the *InputSequence*, and the *Input MTU* block (*RxBytes*) is filled with the first frame data. These data are considered as pending until the superordinate system reads the frame data and acknowledges the transfer with the *OutputSequence*. Only then can the module create new frame data and a new *InputSequence* in the *Input MTU* block. The sequence is then repeated.

To optimize the transfer bandwidth, the module can be configured to issue up to seven *Input MTU* blocks in a row to the bus without waiting for intermediate acknowledgments. A strict requirement is that each sequence is read and evaluated by the superordinate system, otherwise a correct sequence of data transfer and sequence acknowledgment is not possible. This can be achieved by using identical cycle times or a *Block Forward Delay*.

The structure of the data transfer and sequence acknowledgment is identical and must be maintained; otherwise an error is detected.

This setting only refers to the receiving direction of the module. In the sending direction (to the module), the application controls the behavior using control bytes.

Block Forward Delay

General

This register specifies a waiting time between sending Input MTU blocks without acknowledgment from the module to the superordinate system. This is required to allow the correct sequence of blocks to be received in the case of asynchronous systems with different cycle times (task classes).

Name	Meaning
Block Forward Delay	0...32767 µsec

Multiple Segments / Segment Size

General

This register configures options for how control bytes are inserted within the *Input MTU* blocks of the data flow.

Name	Meaning
Multiple Segments	Off = Multiple segments not permitted On = Multiple segments permitted
Segment Size	Off = Segment size is maximum MTU size On = Segment size may exceed MTU size

Control bytes contain the information required to reassemble the entire frame from the segments contained in the *Input MTU* blocks.

Segments can have a maximum length of 63 bytes. A frame that is longer than 63 bytes must be split into several segments to be transferred. The end of the entire frame is detected using information in the control byte.

Setting: Multiple Segments Within MTU Not Permitted

If the segment ends before the end of an *Input MTU*, the remaining bytes of the MTU are not used in this transfer cycle. The next segment, starting with a control byte, is not started until the next cycle. Furthermore, the control byte containing the frame end identifier is also received in a separate cycle without additional data.

Setting: Multiple Segments Within MTU

If the segment ends before the end of an *Input MTU*, the remaining bytes of the MTU are immediately filled with the start of the next segment, which starts with a control byte.

Setting: Segment Size Maximum MTU Size

The *Input MTU* block begins each cycle with a control byte in *RxByte1* and the length information contained in it is limited to the MTU size. The cycle that contains the last data segment can be identified using the control byte.

Setting: Segment Size May Exceed MTU Size

The first *Input MTU* block of the segment starts with a control byte that contains the total segment length. If this length is longer than the MTU size, then data only, without control bytes, are transferred in the following cycles until the total segment length has been reached. A new control byte is then inserted in the *Input MTU* for the next segment, depending on the multiple segment setting.

This setting only refers to the receiving direction of the module. In the sending direction (to the module), the application controls the behavior using control bytes.

Upper Threshold / Lower Threshold

Upper Threshold

This register configures the upper threshold of the receive FIFO buffer. If the number of free bytes in the receive FIFO buffer exceeds this upper threshold, the reception status is set to active. This means, for example, that depending on the handshake configuration an XON character is sent, or the RTS line is set to active.

Name	Value range
Upper Threshold	0...4095

Lower Threshold

This register configures the lower threshold of the receive FIFO buffer. If the number of free bytes in the FIFO buffer undershoots the lower threshold, the reception status is set to passive. This means, for example, that depending on the handshake configuration an XOFF character is sent, or the RTS line is set to passive.

Name	Value range
Lower Threshold	0...4095

Receive Idle Time / Transmit Idle Time

Receive Idle Time

This register configures the *Receive Idle Time* (reception timeout). If this timeout elapses after receiving a block and no new data has been received, the frame is considered as complete and is transferred to the superordinate system.

The timeout is specified in characters to produce the same behavior irrespective of the configured baud rate.

Name	Meaning
Receive Idle Time	0...32767

Transmit Idle Time

This register configures the *Transmit Idle Time* (transmission timeout). If several frames are located in the transmission buffer, a break can be generated between frames. This helps the outstation to detect the end of the frame using a *Receive Idle Time*. The timeout is specified in characters to produce the same behavior irrespective of the configured baud rate.

Name	Meaning
Transmit Idle Time	1...32767

Rx Frame Termination Char 1...4 / Tx Frame Termination Char 1...4

Rx Frame Termination Char 1...4

This register configures one of four possible frame termination characters. When receiving this frame end identifier, the frame stored so far is considered as complete and transferred to the superordinate system. All four termination characters are equivalent and are not filtered from the frame.

Name	Meaning
Rx Frame Termination Char 1	0...255 = ASCII code of the frame termination character -1 = Deactivated

Tx Frame Termination Char 1...4

This register configures one of four possible transmission termination characters. When this frame end identifier is sent, the frame is considered as complete and the configured transmission break (*Transmit Idle Time*) is applied. All four transmission termination characters are equivalent and are not filtered from the frame.

Name	Meaning
Tx Frame Termination Char 1	0...255 = ASCII code of the frame termination character -1 = Deactivated

RTS Inversion / CTS Inversion

General

This register configures a physical-level inversion of the two hardware handshake lines RTS and CTS.

Hw Hand Shake Cts Recognition

General

This register configures the hardware handshake line CTS. Correct wiring to the outstation at an active CTS prompt must be observed.

Name	Meaning
Hw Hand Shake Cts Recognition	0 / disabled = CTS line is ignored; data can be sent. 1 / flow control = CTS line active and is used for flow control and transmission release from the outstation.

Hw Handshake Rts Mode

General

This register configures whether the hardware handshake line RTS is held in passive mode. Only one register can be configured to control the RTS line.

Name	Meaning
Hw Handshake Rts Mode	0 / disabled = RTS line available for other flow control methods 16 / flow control = RTS line held in passive mode

Sw Handshake Xon Char / Sw Handshake Xoff Char

Sw Handshake Xon Char

This register configures the ASCII code of the XON character used for software handshaking flow control. To use software handshaking, an XOFF character must also be defined. The default value is 17. However, any other value can be configured.

Name	Meaning
Sw Handshake Xon Char	-1 = No software handshaking 17 = ASCII code of standard XON character

Sw Handshake Xoff Char

This register configures the ASCII code of the XOFF character used for software handshaking flow control. To use software handshaking, an XON character must also be defined. The default value is 19. However, any other value can be configured.

Name	Meaning
Sw Handshake Xoff Char	-1 = No software handshaking 19 = ASCII code of standard XOFF character

Sw Handshake Period

General

This register configures a repeat time for resending the XON/XOFF character. This can remove blockages of the interface.

Name	Meaning
Sw Handshake Period	0 = Automatic status repetition disabled (default) 500...10000 = Repeat time (ms)

Data Exchange

General

The data sent to and received from the serial interface are transferred in the cyclic data area.

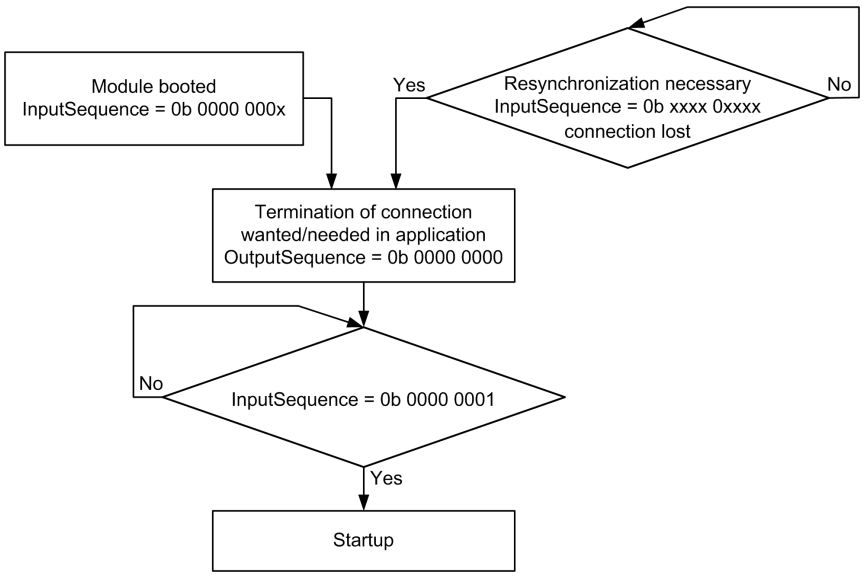
The sequence register, the control bytes within the MTU, and the serial data itself are all part of the handshake protocol between the module and the superordinate system.

In the following sections, the steps required to operate the interface are explained.

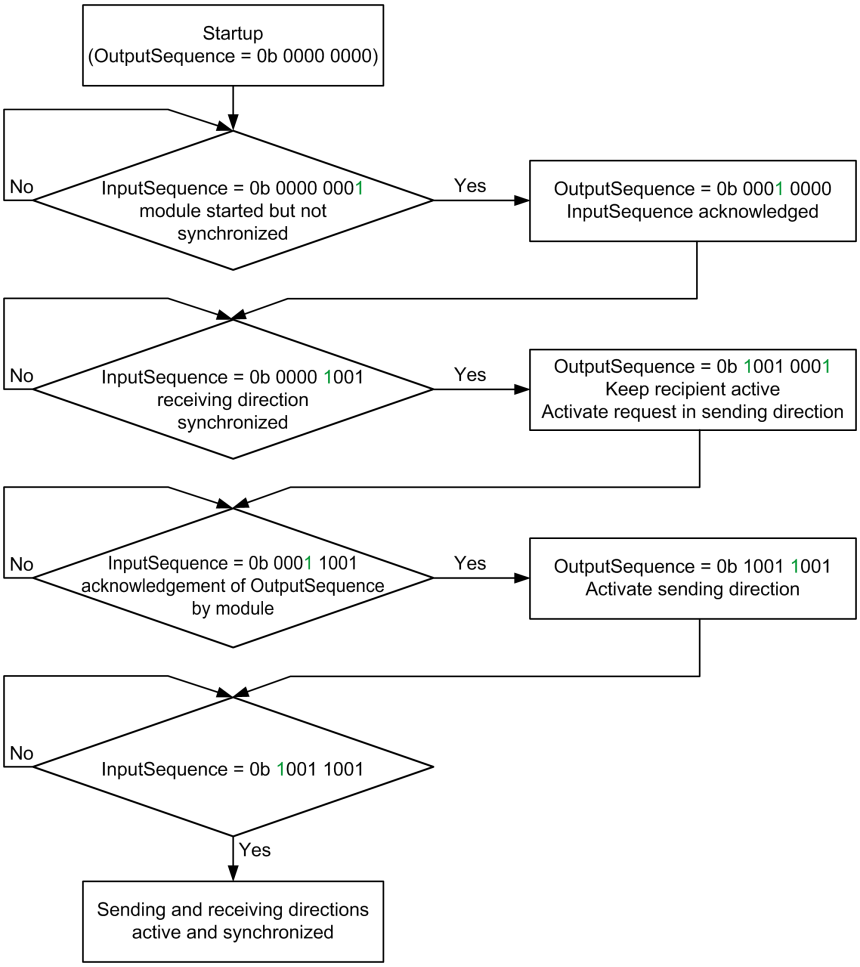
Synchronization of Readiness to Send and Receive

General

The start position is achieved when the first module starts up, when it has disconnected the connection, or when send/receive readiness has been terminated using the *OutputSequence* register. The module is reset to the default state. Depending on the program and the bus cycle times, it is possible that a value of 0 in the *InputSequence* is not read, as it is only present for a short time.



The following figure shows the synchronization procedure using the *InputSequence* and *OutputSequence* registers.



General Information

The figure above shows the sending and receiving directions synchronized in one direction. Synchronization is also possible in the opposite direction.

If the receiving direction is activated, the module can begin transferring data using the MTU even if the sending direction has not yet been synchronized.

If transfer is only required in one direction, the unused transfer direction must not be activated.

Both transfer directions can be handled independently by the application.

Sending and Receiving

General

The following explains the use of the *Input MTU* and *Output MTU* buffers.

The frame length and the operational configuration result in different combinations of control bytes and data bytes on the serial interface.

Each frame contains at least one control byte. Depending on the frame length, the frame may be split into several segments and MTUs.

When receiving data, the position of the data and control bytes within the MTU is determined by the configuration: see Multiple Segments / Segment Size, page 118 and Block Forward, page 117.

When transmitting data, the procedure and structure can be selected as required by the application.

Depending on the combinations, the following options are available:

- Maximizing control and monitoring of the individual steps
- Maximizing data throughput

Maximizing Control and Monitoring of the Individual Steps

- No MTU block forwarding
- Single segment within the MTU
- Segment size does not exceed MTU size

Advantages:

- Clearly structured control bytes are at the start of the MTU.

Disadvantages:

- Low data throughput

Maximizing Data Throughput

- Forwarding of MTU blocks
- Multiple segments within the MTU
- Segment size exceeds MTU size

This configuration optimizes data throughput.

Advantages:

- High data throughput by using forwarding and multiple segments in an MTU

Disadvantages:

- Greater programming effort

In the event of a cycle error detected (sequence number lost) or an occupied transmission buffer, error handling is identical: the procedure must be repeated starting at the first unacknowledged sequence number.

Receipt of a valid sending sequence number only acknowledges data transfer into the transmission buffer: it is not acknowledgment that the frame has actually been sent. Depending on the transfer distance, acknowledgment of the sending sequence number can take several cycles.

A change in value of the receive sequence number acknowledgment in the *InputSequence* indicates that new data received from the module are pending. Each receive sequence number must be acknowledged using the receive sequence number acknowledgment in the *OutputSequence*; otherwise, the connection to the module is disconnected.

Transmit Data: Preparing the Cyclic Data, Maximizing Control and Monitoring

General

The following procedures for varying frame lengths demonstrate that no changes are required within the MTU when transferring in blocks with length specifications. The steps of the process and the position of the control bytes are identical; only the number of cycles required to complete the data transfer changes.

Frame Length < Output MTU Size

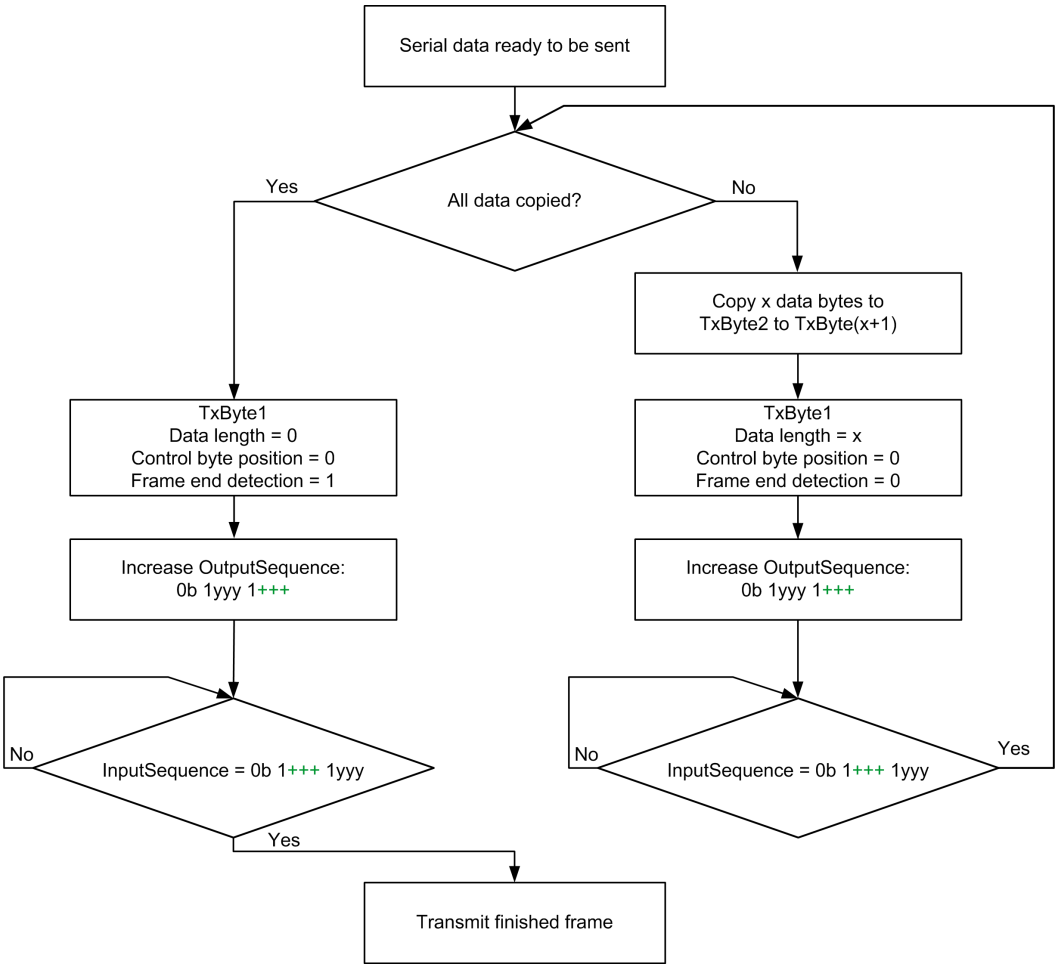
If the frame length is at least one byte less than the *Output MTU* size, only one control byte is required and fits into the *Output MTU*.

Step	Action
1	Copy the serial data into *TxByte2* to *TxByteX*.
2	Create the control byte in *TxByte1*. Specify the length of data in the MTU and set frame end detection = 0.
3	Increase the sending sequence number in the *OutputSequence*. The module copies data to the transmission buffer during the next cycle.
4	Wait until the sending sequence number is acknowledged as confirmation of the data transfer in the *InputSequence*.
5	Create a control byte in *TxByte1*. Specify data length = 0 and set frame end detection = 1.
6	Increase the sending sequence number in the *OutputSequence*. The frame end is detected by the module and the frame is released for sending.
7	Wait until the sending sequence number acknowledgment appears as feedback in the *Input-Sequence* to confirm that the frame has been received. A new frame can then be started.

Frame Length ≥ *Output MTU* Size

Step	Action
1	Copy the first block of serial data into *TxByte2* to *TxByteX*.
2	Create the control byte in *TxByte1*. Specify the length of data in the MTU and set frame end detection = 0.
3	Increase the sending sequence number in the *OutputSequence*. The module copies data to the transmission buffer during the next cycle.
4	Wait until the sending sequence number acknowledgment appears as confirmation of the data transfer in the *InputSequence*.
5	Repeat steps 1 to 4 until the serial data have been transferred in blocks.
6	Create the control byte in *TxByte1*. Set data length = 0 and frame end detection = 1.
7	Increase the sending sequence number in the *OutputSequence*. The frame end is detected by the module and the frame is released for sending.
8	Wait until the sending sequence number acknowledgment appears as feedback in the *InputSequence*, confirming that the frame has been transmitted. A new frame can then be started.

Data Transmission Flow Chart: Preparation of the Cyclic Data, Maximum Control and Monitoring of the Individual Steps



Data Transmission: Use of the Block Forward Mechanism

Data throughput can be increased considerably by using the *Block Forward* mechanism. The mandatory steps are the same. However, the next block is sent immediately in the next cycle, without waiting for acknowledgment of the previous block. The response time for each MTU block between writing to the module and reading the acknowledgment from the module is therefore removed. A maximum of seven unacknowledged MTU blocks can be issued in this way.

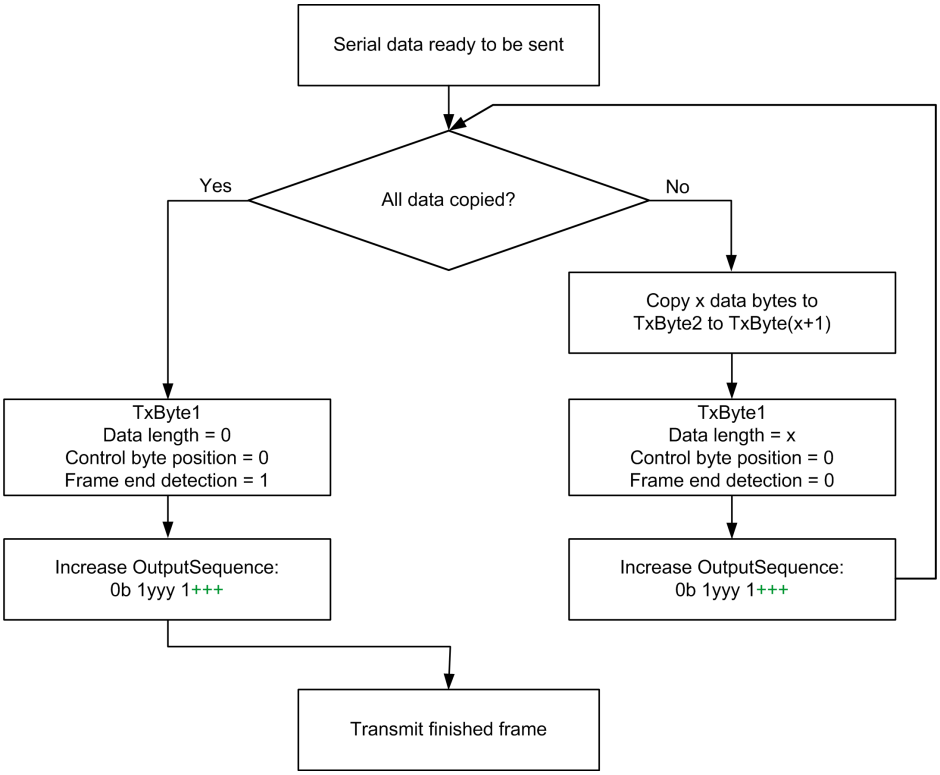
Step	Action
1	Copy the first block of serial data into *TxByte2* to *TxByteX*.
2	Create the control byte in *TxByte1*. Specify the data length in the MTU and set frame end detection = 0.
3	Increase the sending sequence number in the *OutputSequence*. The module copies data to the transmission buffer during the next cycle.
4	Repeat steps 1 to 3 until the serial data have been transferred in blocks.
5	Create the control byte in *TxByte1*. Specify data length = 0 and frame end detection = 1.
6	Increase the sending sequence number in the *OutputSequence*. The frame end is detected by the module and the frame is released for sending.

General Information

The cyclic acknowledgments of the transferred sending sequence number of the previous blocks in the *InputSequence* provide confirmation that these blocks have been received. If the sending sequence number remains unacknowledged, the procedure must be repeated, starting from the first unacknowledged sequence number.

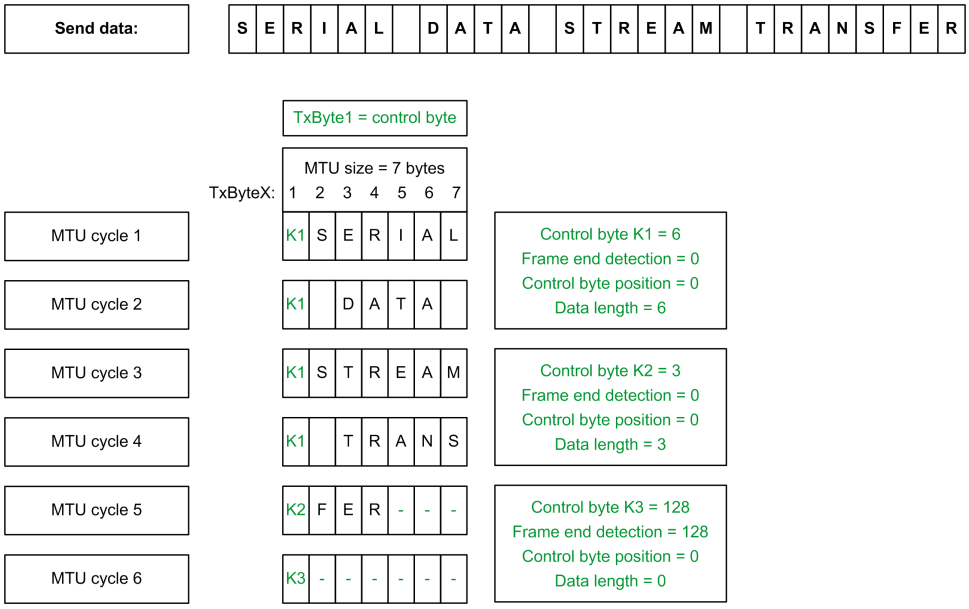
To monitor throughput in the hardware system, it is necessary to determine the number of cycles between increasing the sending sequence number and receiving the acknowledgment. The number of cycles may vary considerably, depending on the relationship between task classes, network cycle times, and the topology of the available network.

Data Transmission Flow Chart: Use of the Block Forward Mechanism



Example: Partitioning Control Byte and Transmission Data

A 27 byte long frame is to be transferred. The MTU size is set to 7 bytes.



The process of preparing and splitting up the transmission data is the same, regardless of whether the *Block Forward* mechanism is used:

- Without use of the *Block Forward* mechanism after the MTU cycles for the transfer of the transmission data, it waits for acknowledgment of the sending sequence number.
- With use of the *Block Forward* mechanism, the subsequent data block is transferred immediately in the next cycle.

In both cases, a new frame can only be started after MTU cycle 6.

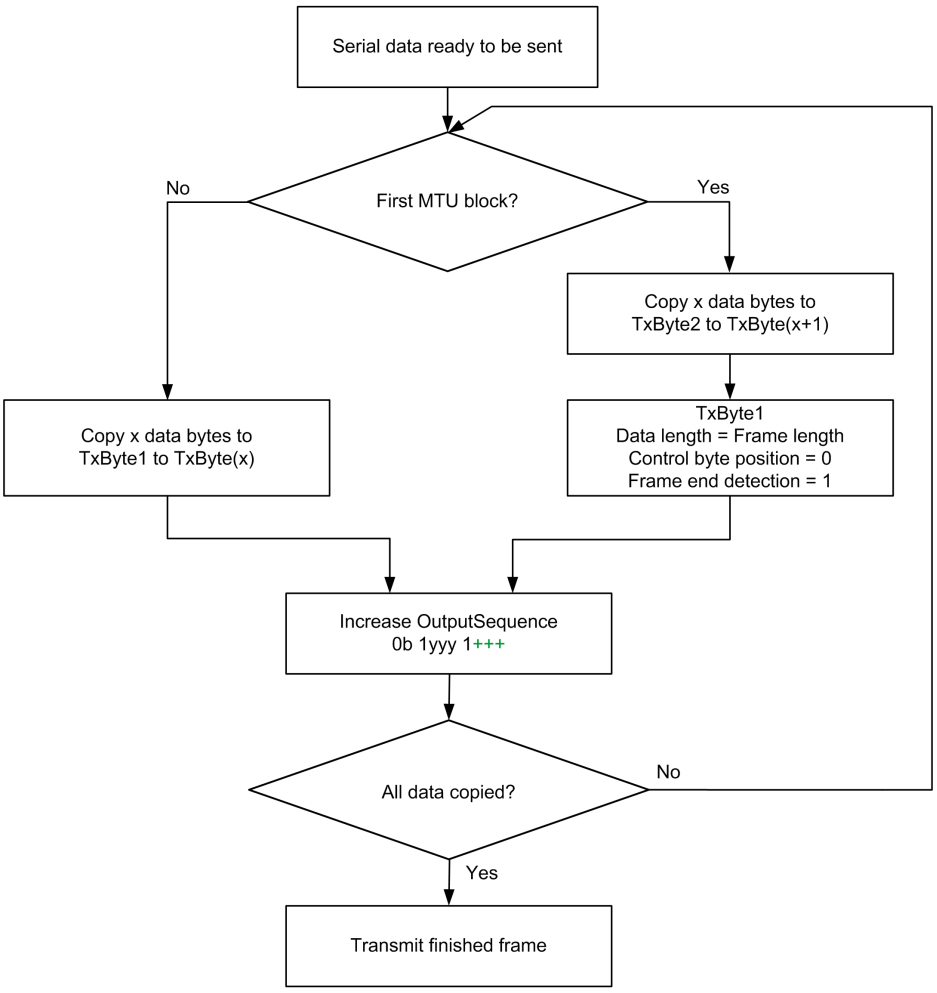
Transmit Data: Preparing Cyclic Data, Maximizing Data Throughput, Frame Length ≤ Maximum Segment Size (63 Bytes)

General

NOTE: From the second MTU block onwards, the serial data starts in *TxByte1*; there are no more control bytes.

Step	Action
1	Copy the first block of serial data into *TxByte2* to *TxByteX*.
2	Create the control byte in *TxByte1*. Specify the frame length and set frame end detection =1.
3	Increase the sending sequence number in the *OutputSequence*. The module copies data to the transmission buffer during the next cycle.
4	When using the *Block Forward* mechanism, repeat steps 1 to 3 until the serial data have been transferred in blocks. With the last block, the module detects that the end of the frame has been reached and releases the frame for sending. A new frame can be started immediately in the next cycle.
5	The cyclic acknowledgments of the transferred sending sequence number of blocks in the *InputSequence* confirm that these blocks have been received. If the sending sequence number remains unacknowledged, the procedure must be repeated starting from the first unacknowledged sequence number.

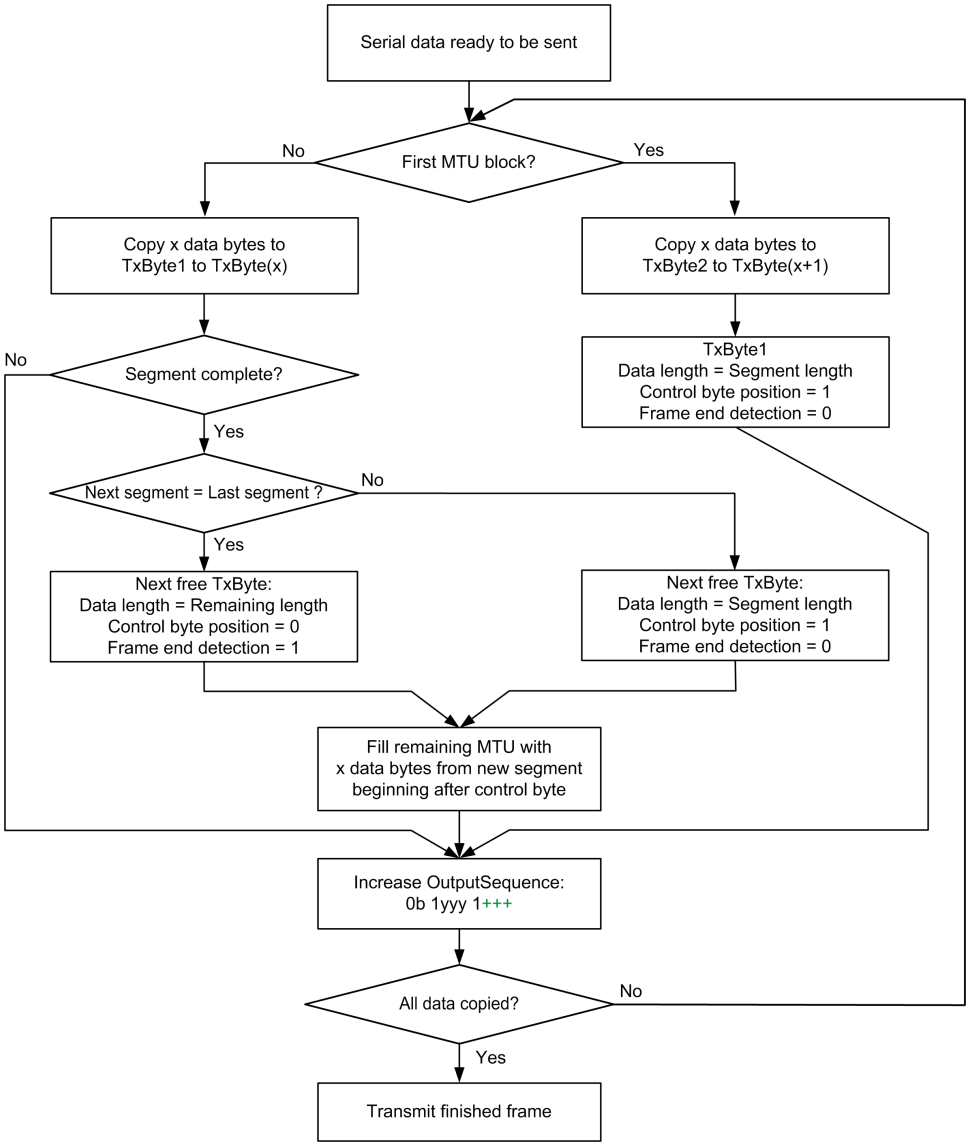
Data Transmission Flow Chart: Preparing Cyclic Data, Maximizing Data Throughput, Frame Length ≤ Maximum Segment Size



Frame Length > Maximum Segment Size

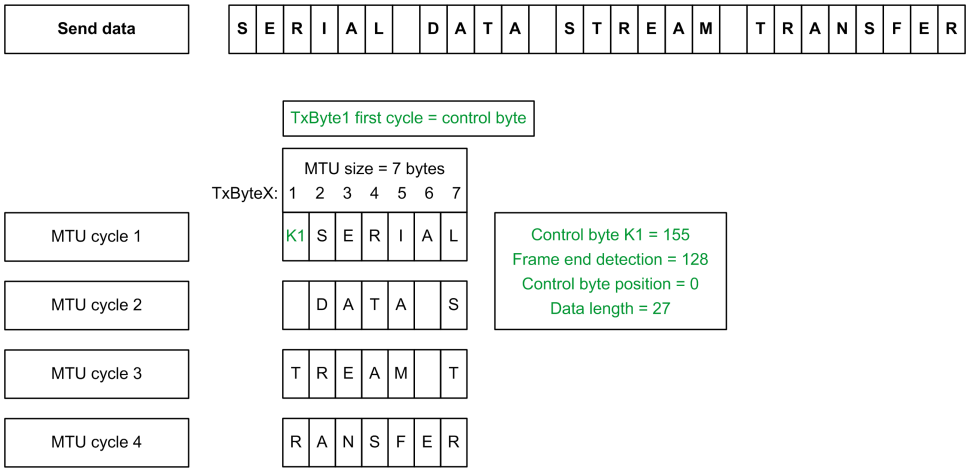
NOTE: From the second MTU block onwards, the serial data starts in *TxByte1*; there are no more control bytes.

Step	Action
1	Copy the first block of serial data into *TxByte2* to *TxByteX*.
2	Create the control byte in *TxByte1*. Specify the segment length, control byte position = 1, and frame end detection = 0.
3	Increase the sending sequence number in the *OutputSequence*. The module copies data to the transmission buffer during the next cycle.
4	When using the *Block Forward* mechanism, repeat steps 1 to 3 until the data of the first segment have been transferred in blocks.
5	If unallocated *TxBytes* still exist in the first segment, with control byte position = 1, the next segment starts immediately in the first unallocated *TxByte* and the remaining bytes are filled with data. With control byte position = 0, the next segment starts in the next new MTU.
6	Repeat steps 1 to 5 to transfer the frame segments in blocks. In the control byte of the last segment, set frame end detection = 1. With the last block of the last segment, the module detects that the frame length has been reached and releases the frame to be sent. A new frame can be started immediately in the next cycle.
7	Cyclic acknowledgment of the transferred sending sequence numbers of the previous blocks/segments in the *InputSequence* confirms that the blocks have been received. If the sending sequence number remains unacknowledged, the procedure must be repeated starting from the first unacknowledged sequence number.



Example: Partitioning Control Byte and Transmission Data

A frame with 27 bytes is to be transferred. The MTU size is configured to 7 bytes.



In contrast to the figure in Transmit Data: Preparation of the Cyclic Data, Maximum Organization, and Monitoring of the Individual Steps, page 125), this results in a saving of two MTU cycles for the same frame length and MTU size. A new frame can be started after the last MTU cycle 4.

When preparing or splitting up the transmission data, it makes no difference whether the *Block Forward* mechanism is used:

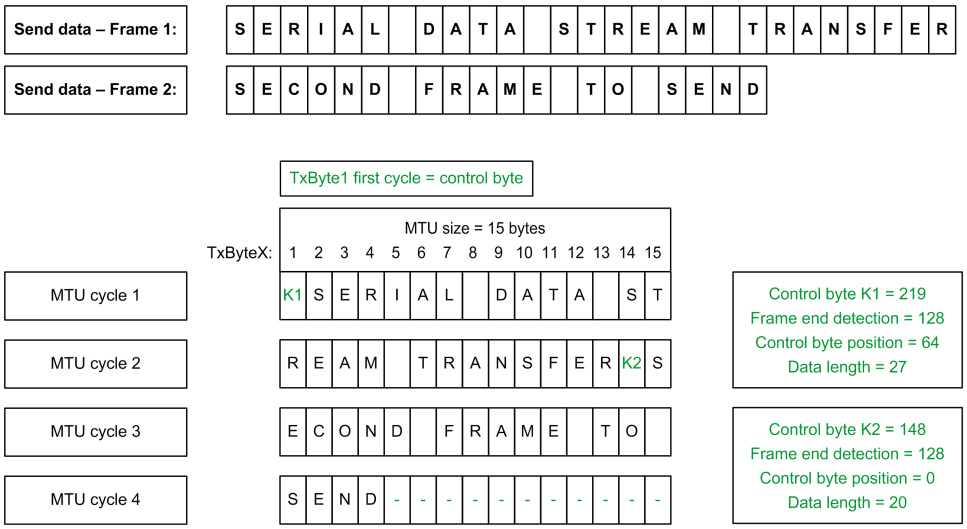
- Without use of the *Block Forward* mechanism after the individual MTU cycles for the transfer of the transmission data, the module waits for acknowledgment of the sending sequence number.
- With use of the *Block Forward* mechanism, the next data block is transferred immediately in the next cycle.

Further Optimization

To use available space in the last MTU block of the frame for the next frame, set the control byte position = 1 identifier in the last control byte of the frame. The first unallocated *TxByte* in the last MTU block is then used as the control byte for the next frame. The MTU is then filled with the serial data of the new frame until the end of the data. The serial data in the next cycle starts in *TxByte1*.

Example Partitioning Control Byte and Transmission Data

Two frames with 27 bytes and 20 bytes are to be transferred. The MTU size is set to 15 bytes.



Receive Data: Read Cyclic Data, Maximizing Control, and Monitoring

General

In contrast to sending, when receiving the behavior regarding the use of the MTU by the module is determined by the configuration.

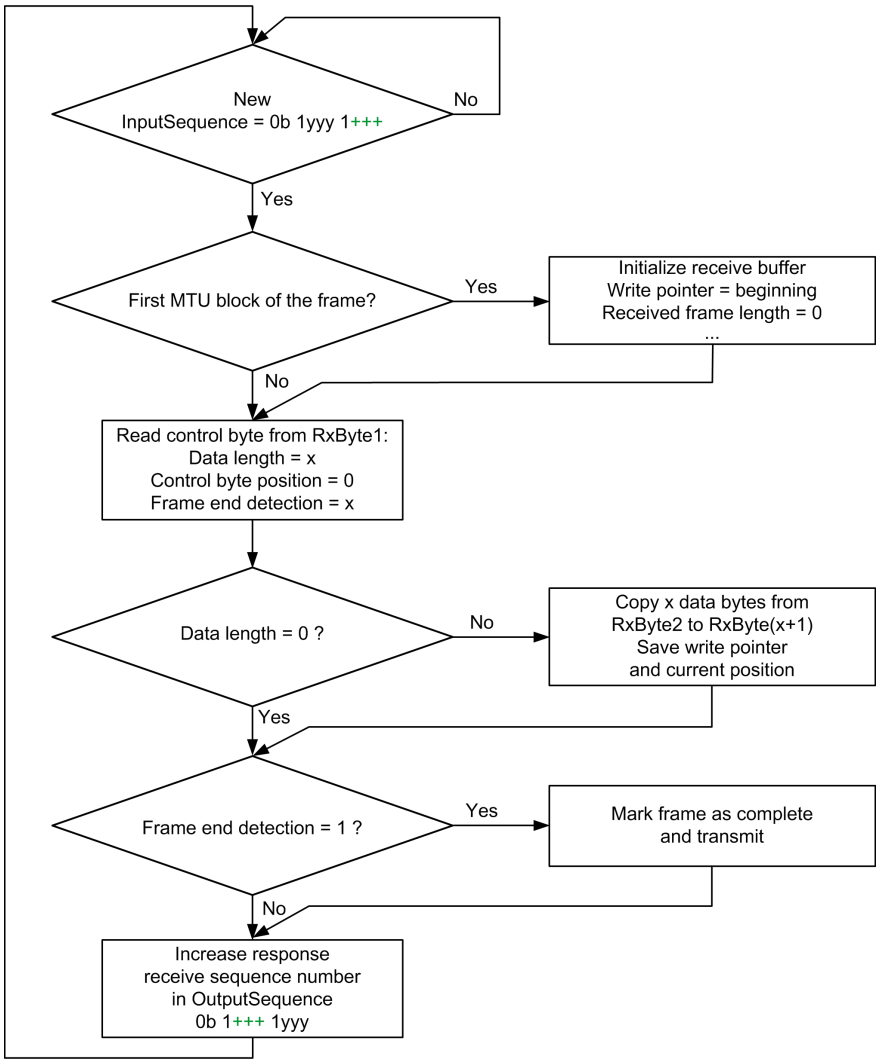
Configuration

To maximize control and monitoring of the individual steps, set the configuration as follows:

- Multiple segments within an MTU are not permitted
- Segment size does not exceed MTU size
- Use or not of the *Block Forward* mechanism makes no difference to MTU processing

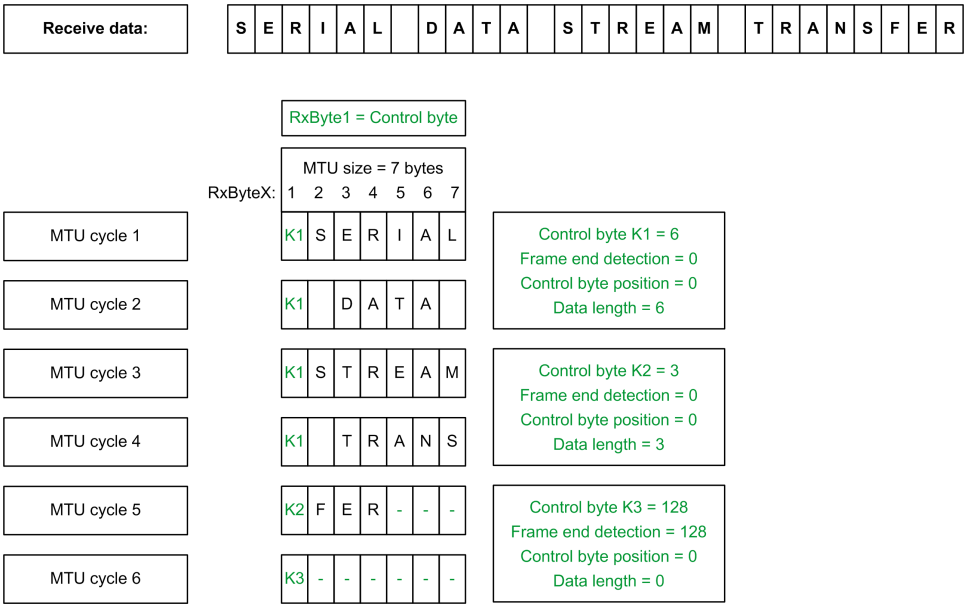
Step	Action
1	Verify whether the receiver sequence number in the *OutputSequence* has changed since the last cycle. If it has changed, *RxByte1* is a control byte. If it is the start of a frame, the receive buffer must be initialized (write pointer to start of buffer, received frame length = 0, and so on).
2	Evaluate the control byte information in *RxByte1* to determine the length of data in the MTU and whether frame end detection has been set.
3	If data are available, copy the first block of serial data from *RxByte2* to *RxByteX*. Save the write pointer position and add the new frame length. If frame end detection has been set, mark the frame as complete.
4	Increase the value of the receiver sequence number acknowledgment in the *OutputSequence*. If *Block Forward* = 1, the next MTU block is prepared only after the module has received acknowledgment of the cyclic transfer. If *Block Forward* = 2 to 7, the module does not wait for individual acknowledgments, but creates new MTU blocks until the specified number of blocks is reached.
5	Repeat steps 1 to 4 until the serial data have been received in blocks.

Data Reception Flow Chart: Maximum Control With/Without Block Forward



Example of Partitioning Control Byte and Received Data

The MTU is configured to 7 bytes. A frame with 27 bytes is received.



Receive Data: Read Cyclic Data, Maximizing Data Throughput

General

In contrast to sending, when receiving the behavior regarding the use of the MTU by the module is determined by the configuration.

Configuration

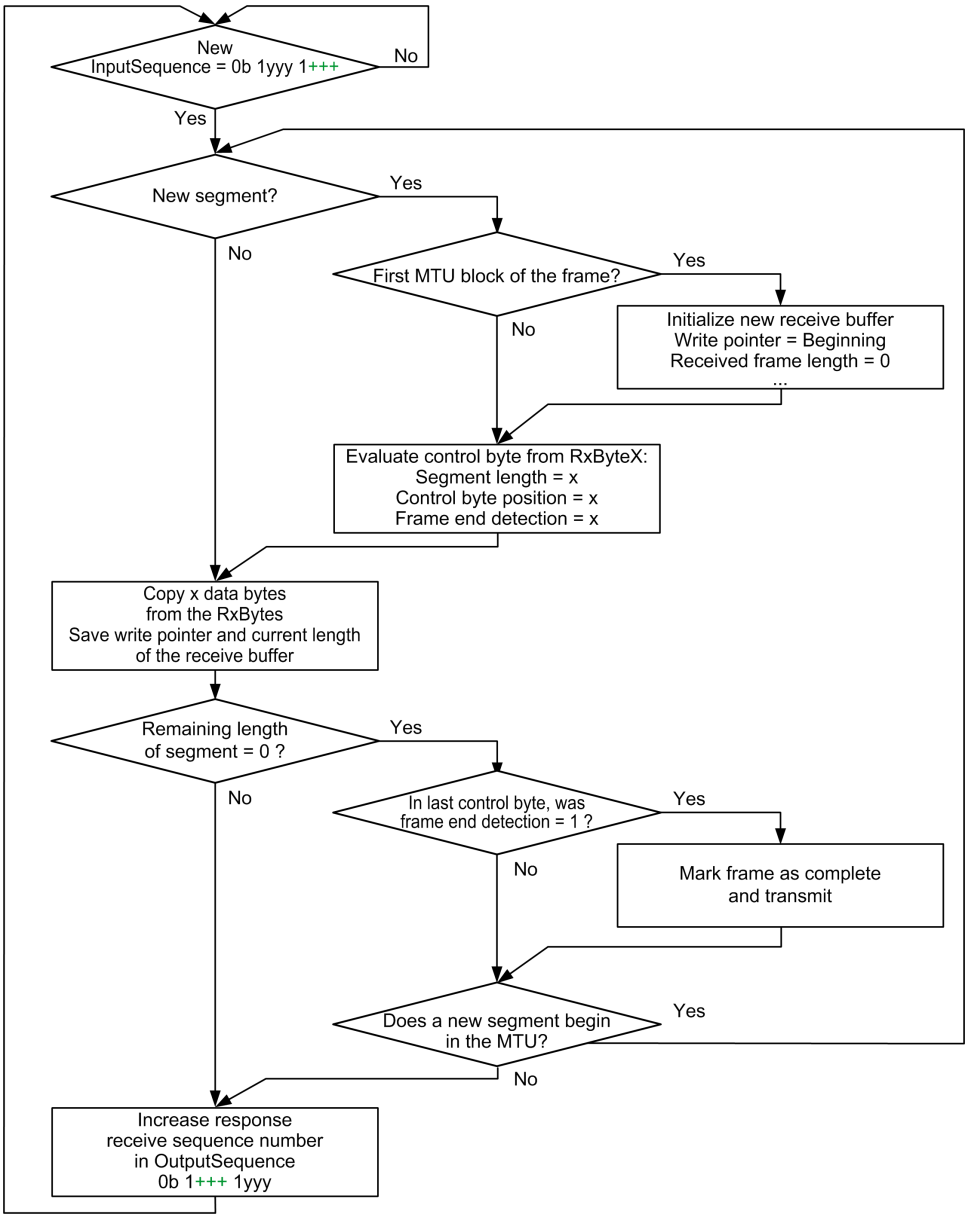
To maximize data throughput, set the configuration as follows:

- Multiple segments within MTU permitted: control byte position = 1. The last data byte of the segment is immediately followed by the control byte for the next segment.
- Segment size may exceed the MTU size: only the first MTU of the segment contains the control byte of the segment, the following MTU blocks only contain data.
- Use the *Block Forward* mechanism: the module transfers up to seven unacknowledged MTU blocks.

Step	Action
1	Verify whether the receive sequence number has changed since the last cycle. If it is the beginning of a frame, initialize the receiver buffer (write pointer to start of buffer, received frame length = 0, and so on). The optimized transfer means that several short frames may be contained in one MTU, so it must be possible to manage a sufficient number of receive buffers with the application. Determine the control byte position in the MTU. If *RxByte1* is the control byte, it is an MTU containing no residual data of the previous segment (or frame). If the first unallocated *RxBytex* is the control byte for the new segment, it is an MTU containing residual data of the previous frame. MTU blocks within a segment do not necessarily have a control byte.
2	Evaluate the control byte information from *RxBytex*. Determine the data length, segment length, and next control byte position. If frame end detection is set, it is the last segment.

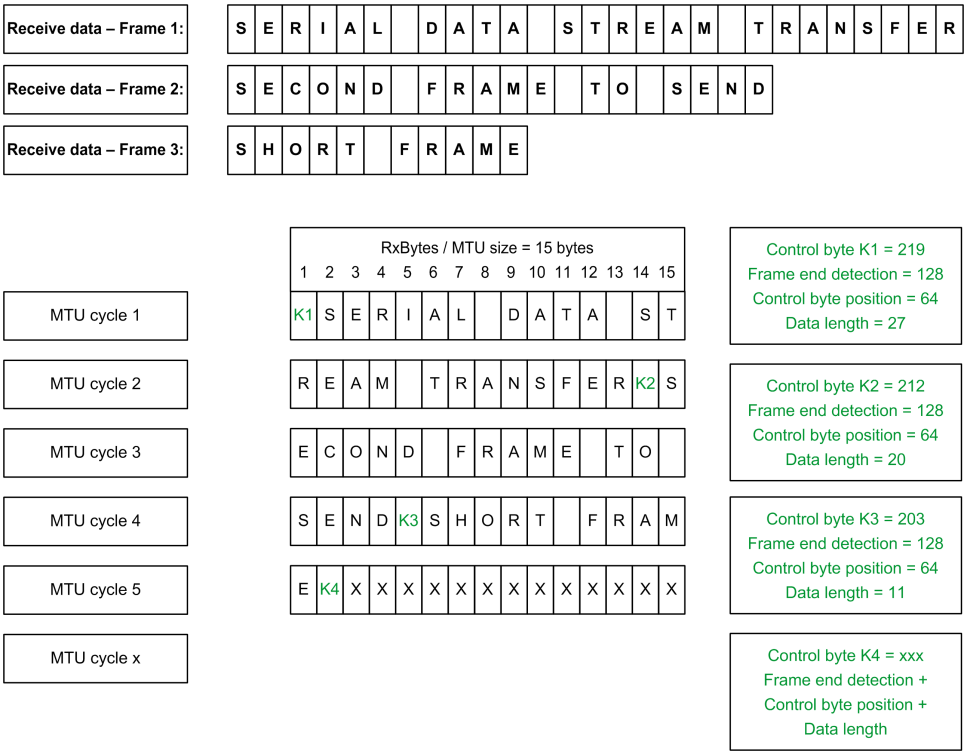
Step	Action
3	If data are available, copy the block of serial data starting from *RxBytex*. Save the write pointer position and add the new frame length. Calculate the residual length of the segment. The next *RxBytex* may already be a control byte for the next segment or frame. When frame end detection is set and the data have been copied, mark the frame as complete.
4	Increase the value of the receiver sequence number acknowledgment in the *OutputSequence*.
5	Repeat steps 1 to 4 until the serial data have been received in blocks.

Data Reception Flow Chart: Optimize Data Throughput



Example of Partitioning Control Byte and Transmission Data

The MTU is configured to 15 bytes, frames are being received: 27 bytes, 20 bytes, 11 bytes,...



Glossary

A

analog input:

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

analog output:

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

C

compact I/O module:

An inseparable group of 5 analog and/or digital I/O electronic modules in a single reference.

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.

D

digital I/O:

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

E

expansion bus:

An electronic communication bus between expansion I/O modules and a controller or bus coupler.

G

GVL:

(*global variable list*) Manages global variables within an EcoStruxure Machine Expert project.

H

hex:

(*hexadecimal*)

N

network:

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

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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