BECKHOFF New Automation Technology

Manual | EN

TF6255 TwinCAT 3 | Modbus RTU



Table of contents

1	Fore	⁵ oreword 5				
	1.1 Notes on the documentation					
	1.2	For your	safety	. 5		
	1.3	Notes or	n information security	. 7		
2	Over	view		. 8		
3	Insta	llation		. 9		
	3.1	System I	Requirements	. 9		
	3.2	Installati	on	. 9		
	3.3	Licensing	g	12		
4	Conf	iguration		15		
	4.1	Terminal	l configuration	15		
	4.2	Modbus	address arrays	15		
5	PLC	API		18		
5.1 Function blocks				18		
		5.1.1	[obsolete]	18		
		5.1.2	ModbusRtuMasterV2_PcCOM	25		
		5.1.3	ModbusRtuMasterV2_KL6x22B	28		
		5.1.4	ModbusRtuMasterV2_KL6x5B	31		
		5.1.5	ModbusRtuMasterV2_Generic	34		
		5.1.6	ModbusRtuSlave_PcCOM	37		
		5.1.7	ModbusRtuSlave_KL6x22B	38		
		5.1.8	ModbusRtuSlave_KL6x5B	40		
		5.1.9	ModbusRtuSlave_Generic	41		
	5.2	Datatype	9S	43		
		5.2.1	Modbus station address	43		
	5.3	Global C	constants	43		
		5.3.1	Global_Version	43		
6	Appe	ndix		44		
	6.1 Modbus RTU Error Codes 4					

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1 Foreword

1.1 Notes on the documentation

This description is intended exclusively for trained specialists in control and automation technology who are familiar with the applicable national standards.

For installation and commissioning of the components, it is absolutely necessary to observe the documentation and the following notes and explanations.

The qualified personnel is obliged to always use the currently valid documentation.

The responsible staff must ensure that the application or use of the products described satisfies all requirements for safety, including all the relevant laws, regulations, guidelines, and standards.

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

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1.2 For your safety

Safety regulations

Read the following explanations for your safety.

Always observe and follow product-specific safety instructions, which you may find at the appropriate places in this document.

Exclusion of liability

All the components are supplied in particular hardware and software configurations which are appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation, and drive technology who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

Hazard with high risk of death or serious injury.				
Hazard with medium risk of death or serious injury.				
There is a low-risk hazard that could result in medium or minor injury.				

Warning of damage to property or environment

NOTICE The environment, equipment, or data may be damaged.

Information on handling the product

This information includes, for example: recommendations for action, assistance or further information on the product.

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To stay informed about information security for Beckhoff products, subscribe to the RSS feed at <u>https://www.beckhoff.com/secinfo</u>.

2 Overview

TwinCAT 3 Modbus RTU offers function blocks for serial communication with Modbus terminal devices.



Modbus RTU devices are connected to a Beckhoff Controller via a serial interface. The TwinCAT PLC uses slave function blocks of the Modbus RTU library for communication with my Modbus master (slave mode). In addition, master function blocks are available for addressing several Modbus slaves (master mode)

Supported interfaces

- Serial COM port of a PC or CX
- Serial Bus Terminals KL60xx
- Serial EtherCAT Terminals EL60xx
- · Virtual serial COM port (USB port) of a PC or CX
 - With additional use (and licensing) of TF6340 TC3 Serial Communication

Further documentation

Technical details and specification about Modbus can be found under: http://www.modbus.org

Boundary conditions

The Modbus protocol defines accurate timing to ensure, for example, the complete transfer of all characters of a telegram. Since the communication Modbus RTU is realized on a PLC controller, accurate timing cannot be guaranteed due to the cyclic execution of the PLC program. Most end devices are very tolerant and function without problems in the event of short time gaps between characters. In individual cases, the behavior of the end device should be checked.

The second channel of an EL60x2 is not suitable for Modbus RTU communication, because it is processed with low priority, which means the frames are sent with gaps, which in turn could be detected by the remote terminal as frame errors.



With some serial interface terminals an internal buffer can be filled before sending (option *continuous sending*). The ModbusRTU library can use this feature if it is set in the corresponding serial terminal. For example, on the KL6031 continuous mode can be activated with the *KL6configuration* configuration function block (register 34 bit 6). Up to 128 bytes are then placed in the internal buffer of the Bus Terminal and transmitted continuously.

3 Installation

3.1 System Requirements

Technical data	TF6255 TC3 Modbus-RTU
Target system	Windows XP / 7 / 10 PC or CX (x86, x64, ARM)
Min. TwinCAT version	3.1.0
Min. TwinCAT level	TC1200 TC3 PLC

3.2 Installation

The following section describes how to install the TwinCAT 3 Function for Windows-based operating systems.

- ✓ The TwinCAT 3 Function setup file was downloaded from the Beckhoff website.
- 1. Run the setup file as administrator. To do this, select the command **Run as administrator** in the context menu of the file.
 - \Rightarrow The installation dialog opens.
- 2. Accept the end user licensing agreement and click Next.

😸	x			
License Agreement Please read the following license agreement carefully.	5			
Software Usage Agreement for Beckhoff Software Products				
 § 1 Subject Matter of this Agreement (1) Licensor grants Licensee a non-transferable, non-exclusive right to use the data processing applications specified in Appendix 1 hereto (hereinafter called "Software") under the conditions specified hereinafter. (2) The Software shall be delivered to Licensee on machine-readable recording media as specified in Appendix 1, on which it is recorded as an object program in an executable status. One copy of the user documentation shall be part of the application and it shall be delivered to Licensee in printed form, or also on a machine-readable recording medium or online. The form the user documentation is delivered in is specified in Appendix 1. The Software and the documentation are hereinafter called "isonea Materiale". 				
I accept the terms in the license agreement Print				
I do not accept the terms in the license agreement				

3. Enter your user data.

Customer Information	
Please enter your information.	
<u>U</u> ser Name:	
Max Mustermann	j
Organization:	
Mustermann Inc.	
InstallShield	
< Back N	ext > Cancel

4. If you want to install the full version of the TwinCAT 3 Function, select **Complete** as installation type. If you want to install the TwinCAT 3 Function components separately, select **Custom**.

<mark>⊮</mark>	
Setup Type Choose the set	up type that best suits your needs.
Please select a	setup type.
Complete	All program features will be installed to all installed TwinCAT 3 versions on your system. (Requires the most disk space.)
Custom	Choose which program features you want installed and to which TwinCAT 3 version they will be installed. Recommended for advanced users.
InstallShield	< Back Next > Cancel

5. Select **Next**, then **Install** to start the installation.

	×
Ready to Install the Program The wizard is ready to begin installation.	5
Click Install to begin the installation.	
If you want to review or change any of your installation settings, click Back. Click Cance exit the wizard.	l to
InstallShield	
< Back Install Can	cel

⇒ A dialog box informs you that the TwinCAT system must be stopped to proceed with the installation.

6. Confirm the dialog with **Yes**.

TwinCAT Server Installation	8
TwinCAT system has to be stopped before Should TwinCAT be stopped?	ore proceeding with installation.
	Ves No

7. Select Finish to exit the setup.



⇒ The TwinCAT 3 Function has been successfully installed and can be licensed (see Licensing [▶ 12]).

3.3 Licensing

The TwinCAT 3 function can be activated as a full version or as a 7-day test version. Both license types can be activated via the TwinCAT 3 development environment (XAE).

Licensing the full version of a TwinCAT 3 Function

A description of the procedure to license a full version can be found in the Beckhoff Information System in the documentation "<u>TwinCAT 3 Licensing</u>".

Licensing the 7-day test version of a TwinCAT 3 Function



A 7-day test version cannot be enabled for a TwinCAT 3 license dongle.

- 1. Start the TwinCAT 3 development environment (XAE).
- 2. Open an existing TwinCAT 3 project or create a new project.
- 3. If you want to activate the license for a remote device, set the desired target system. To do this, select the target system from the **Choose Target System** drop-down list in the toolbar.
 - ⇒ The licensing settings always refer to the selected target system. When the project is activated on the target system, the corresponding TwinCAT 3 licenses are automatically copied to this system.

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4. In the Solution Explorer, double-click License in the SYSTEM subtree.



- \Rightarrow The TwinCAT 3 license manager opens.
- 5. Open the **Manage Licenses** tab. In the **Add License** column, check the check box for the license you want to add to your project (e.g. "TF4100 TC3 Controller Toolbox").

0	Order Information (Runtime) Manage Licenses Project Licenses					ne Licenses	
	Disable automa						
	Order No	License	2		Ad	d License	
	TF3601	TC3 Co	ndition Monitoring	g Level 2		cpu licens	e
	TF3650	TC3 Po	wer Monitoring			cpu licens	e
	TF3680	TF3680 TC3 Filter				cpu licens	e
	TF3800	TC3 Machine Learning Inference Engine				cpu licens	e
	TF3810	3810 TC3 Neural Network Inference Engine				cpu licens	e
	TF3900	TC3 So	ar-Position-Algori	thm		cpu licens	e
	TF4100	TC3 Co	ntroller Toolbox		$\overline{}$	cpu licens	e
	TF4110	TC3 Ter	nperature-Control	ler		cpu licens	e
	TF4500	TC3 Sp	eech			cpu licens	e
	-						

- 6. Open the Order Information (Runtime) tab.
 - ⇒ In the tabular overview of licenses, the previously selected license is displayed with the status "missing".

7. Click 7-Day Trial License... to activate the 7-day trial license.

Order Information (Runtime)	Project License	s Online L	icenses			
License Device Tar	get (Hardware Id)		~	Add		
System Id:		Plat	om:			
2DB25408-B4CD-81DF-	5488-6A3D9B49EF	19 oth	er (91)	\sim		
License Request						
Provider: Beckhoff	Automation	~	Generat	e File		
License Id:		Customer Id:				
Comment:						
License Activation						
7 Days Trial Li	Licens	e Response	File			

⇒ A dialog box opens, prompting you to enter the security code displayed in the dialog.

Enter Security Code				
Please type the following 5 characters: Kg8T4	OK			
	Cancel			

- 8. Enter the code exactly as it is displayed and confirm the entry.
- 9. Confirm the subsequent dialog, which indicates the successful activation.
 - ⇒ In the tabular overview of licenses, the license status now indicates the expiry date of the license.
- 10. Restart the TwinCAT system.
- \Rightarrow The 7-day trial version is enabled.

4 Configuration

4.1 Terminal configuration

The KL6001, KL6011, KL6021, KL6031, and KL6041 Bus Terminals can be parameterized with the KS2000 configuration software.

Alternatively, the system can be configured via the PLC function blocks included in the <u>Tc2_SerialCom</u> serial communication library. This means that the KL6configuration function block can be used without a license to configure the bus terminals.



Please note that the other Tc2_SerialCom library blocks that enable communication (and not configuration) require the license for TF6340 TwinCAT 3 Serial Communication.

4.2 Modbus address arrays

Modbus defines access functions for different data areas. These data areas are declared as variables in a TwinCAT PLC program, e.g. as word arrays, and transferred to the Modbus slave function block as input parameters. Each area has a different Modbus start address, so that the areas can be distinguished unambiguously. This offset has to be taken account of for addressing.

Inputs

The *Inputs* data area usually describes the physical input data with read-only access. They can be digital inputs (bit) or analog inputs (word). The PLC programmer can decide whether or not to grant the communication partner direct access to the physical inputs. It is also possible to define an input area for Modbus communication that is not identical with the physical inputs:

Definition of the Modbus input data as direct image of the physical inputs. Start and size of the data area can be specified freely. They are limited by the actual size of the input process image of the controller used.

VAR Inputs AT%IWO : ARRAY[0..255] OF WORD; END VAR

Definition of the Modbus input data as a separate Modbus data area independent of the physical inputs

```
VAR
Inputs : ARRAY[0..255] OF WORD;
END VAR
```

The maximum size of the Input data area is 2048 words (ARRAY[0..2047] OF WORD).

Access to the Input area via a Modbus master is possible with the following Modbus functions:

```
2 : Read Input Status
4 : Read Input Registers
```

Addressing

The *Input* area is addressed with a 0 offset, i.e. address 0 as transferred in the telegram addresses the first element in the Input data area.

Examples:

PLC variable	Access type	Address in the Modbus telegram	Address in the end de- vice (device-dependent)
Inputs[0]	Word	16#0	30001
Inputs[1]	Word	16#1	30002
Inputs[0], Bit 0	Bit	16#0	10001
Inputs[1], Bit 14	Bit	16#1E	1001F

Outputs

The *Outputs* data area usually describes the physical output data with read and write access. *Outputs* can be digital outputs (coils) or analog outputs (output registers). Like for the *Inputs*, the area can be declared as a physical output variable or as a simple variable.

Definition of the Modbus output data as direct image of the physical outputs. Start and size of the data area can be specified freely. They are limited by the actual size of the output process image of the controller used.

VAR Outputs AT%QW0 : ARRAY[0..255] OF WORD; END VAR

Definition of the Modbus output data as a separate Modbus data area independent of the physical outputs

```
VAR
Outputs : ARRAY[0..255] OF WORD;
END VAR
```

The maximum size of the Output data area is 14336 words (ARRAY[0..14335] OF WORD).

Access to the Output area via a Modbus master is possible with the following Modbus functions:

```
1 : Read Coil Status
3 : Read Holding Registers
5 : Force Single Coil
6 : Preset Single Register
15 : Force Multiple Coils
16 : Preset Multiple Registers
```

Addressing

The *Output* area is addressed with a 16#800 offset, i.e. address 16#800 as transferred in the telegram addresses the first element in the Output data area.

Examples:

PLC variable	Access type	Address in the Modbus telegram	Address in the end de- vice (device-dependent)
Outputs[0]	Word	16#800	40801
Outputs[1]	Word	16#801	40802
Outputs[0], Bit 0	Bit	16#800	00801
Outputs[1], Bit 14	Bit	16#81E	0081F

Memory

The Memory data area describes a PLC variable area without physical I/O assignment.

Definition of the Modbus memory data as PLC flags. Start and size of the data area can be specified freely.

```
VAR
Memory AT%MW0 : ARRAY[0..255] OF WORD;
END VAR
```

Definition of the Modbus memory data as variable without flag address

```
VAR
Memory : ARRAY[0..255] OF WORD;
END VAR
```

The maximum size of the *Memory* data area is 16384 words (ARRAY[0..16383] OF WORD).

Access to the Memory area via a Modbus master is possible with the following Modbus functions:

```
3 : Read Holding Registers
6 : Preset Single Register
16 : Preset Multiple Registers
```

Addressing

The *Memory* area is addressed with a 16#4000 offset, i.e. address 16#4000 as transferred in the telegram addresses the first word in the Memory data area.

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Examples:

PLC variable	Access type	Address in the Modbus telegram	Address in the end de- vice (device-dependent)
Memory[0]	Word	16#4000	44001
Memory[1]	Word	16#4001	44002

5 PLC API

5.1 Function blocks

5.1.1 [obsolete]

5.1.1.1 ModbusRtuMaster_PcCOM

	MODBUSRTUMA	STER_PCCOM
		_
_	UnitID	BUSY-
_	Quantity	Error
_	MBAddr	ErrorId
_	cbLength	cbRead —
_	pMemoryAddr	
-	Execute	
-	Timeout	

The function block ModbusRtuMaster_PcCOM implements a Modbus master that communicates via a serial PC interface (COM port). The function block <u>ModbusRtuMaster_KL6x5B [>20]</u> is available for communication via a serial Bus Terminal KL6001, KL6011 or KL6021.

Hardware connection

The data structures required for the link with the communication port are included in the function block. They are displayed in the TwinCAT System Manager once the PLC program has been integrated and can be connected with a COM port. The procedure is analogous to the description in the <u>chapter Serial PC Interface</u> of the TF6340 TC3 Serial Communication documentation.

The function block is not called in its basic form, but individual actions of that block are used within a PLC program. Each Modbus function is implemented as an action.

Supported Modbus functions (actions)

ModbusMaster.ReadCoils
 Modbus function 1 = Read Coils

Reads binary outputs (coils) from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.ReadInputStatus Modbus function 2 = Read Input Status

Reads binary inputs from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

- ModbusMaster.ReadRegs Modbus function 3 = Read Holding Registers Reads data from a connected slave.
- ModbusMaster.ReadInputRegs

Modbus function 4 = *Read Input Registers*

Reads input registers from a connected slave.

ModbusMaster.WriteSingleCoil
 Modbus function 5 = Write Single Coil

Sends a binary output (coil) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

ModbusMaster.WriteSingleRegister
 Modbus function 6 = Write Single Register
 Sends a single data word to a connected slave

ModbusMaster.WriteMultipleCoils

Modbus function 15 = Write Multiple Coils

Sends binary outputs (coils) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteRegs Modbus function 16 = Preset Multiple Registers

Sends data to a connected slave

• **ModbusMaster.Diagnostics** Modbus function 8 = *Diagnostics*

Sends a diagnostic request to the slave with a user-specified function code (subfunction code). Since this function does not address a memory, the function code is transferred in the data word MBAddr. Any data required for the function is included in pMemoryAddr.

🐔 Inputs

VAR	INPUT				
	UnitID	:	UINT;		
	Quantity	:	WORD;		
	MBAddr	:	WORD;		
	cbLength	:	UINT;		
	pMemoryAddr	:	POINTER	то	BYTE;
	Execute	:	BOOL;		
	Timeout	:	TIME;		
END	VAR				

Name	Туре	Description	
UnitID	UINT	Modbus <u>station address</u> [▶ <u>43</u>] (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address (see <u>UnitID</u> [▶ <u>43</u>])	
Quantity	WORD	Number of data words to be read or written for word- oriented Modbus functions. For bit-oriented Modbus functions, Quantity specifies the number of bits (inputs or coils).	
MBAddr	WORD	Modbus data address, from which the data are read from the end device (slave). This address is transferred unchanged to the slave and is interpreted there as data address. With the <i>Diagnostics</i> function (8) the function code (subfunction code) is transferred here.	
cbLength	UINT	Size of the data variable used for send or read actions in bytes. cbLength must be greater than or equal to the amount of data transferred as determined by Quantity. For word accesses, for example: [cbLength >= Quantity * 2]. cbLength can be calculated with SIZEOF(Modbus data).	
pMemoryAddr	BYTE	Memory address in the PLC, calculated with ADR (Modbus data). For read actions, the read data are stored in the addressed variable. For send actions, the data are transferred from the addressed variable to the end device.	
Execute	BOOL	Start signal. The action is triggered by a rising edge at the Execute input.	
Timeout	TIME	Timeout value for waiting for a response from the addressed slave.	

Outputs

VAR_OUTPUT BUSY : BOOL; Error : BOOL;

Name	Туре	Description
Busy	BOOL	Indicates that the function block is active. <i>Busy</i> becomes TRUE with a rising edge at <i>Execute</i> and becomes FALSE again once the started action is completed. At any one time, only one action can be active.
Error	BOOL	Indicates that an error occurred during execution of an action.
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.
cbRead	UINT	Provides the number of read data bytes for a read action.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.1.2 ModbusRtuMaster_KL6x5B

MODBUSRTUMAS	TER_KL6×5B
UnitID Quantity MBAddr cbLength pMemoryAddr Execute Timeout	BUSY— Error— ErrorId— cbRead—

The function block ModbusRtuMaster_KL6x5B realizes a Modbus master, which communicates via a serial Bus Terminal KL6001, KL6011 or KL6021.

i

Hardware connection

The data structures required for the link with the communication port are included in the function block. On a PC, the assignment in the TwinCAT System Manager is analogous to the description in the <u>chapter Serial bus terminal</u> of the TF6340 TC3 Serial Communication documentation.

The function block is not called in its basic form, but individual actions of that block are used within a PLC program. Each Modbus function is implemented as an action.

Supported Modbus functions (actions)

ModbusMaster.ReadCoils

```
Modbus function 1 = Read Coils
```

Reads binary outputs (coils) from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.ReadInputStatus Modbus function 2 = Read Input Status

Reads binary inputs from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

- ModbusMaster.ReadRegs Modbus function 3 = Read Holding Registers Reads data from a connected slave.
- ModbusMaster.ReadInputRegs Modbus function 4 = Read Input Registers

Reads input registers from a connected slave.

• ModbusMaster.WriteSingleCoil Modbus function 5 = Write Single Coil

Sends a binary output (coil) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

ModbusMaster.WriteSingleRegister
 Modbus function 6 = Write Single Register

Sends a single data word to a connected slave

- ModbusMaster.WriteMultipleCoils
 Modbus function 15 = Write Multiple Coils

 Sends binary outputs (coils) to a connected slave. The data must be ready to send in compressed form
- (8 bits per byte) from the specified address pMemoryAddr.ModbusMaster.WriteRegs

Modbus function 16 = Preset Multiple Registers

Sends data to a connected slave

• ModbusMaster.Diagnostics Modbus function 8 = Diagnostics

Sends a diagnostic request to the slave with a user-specified function code (subfunction code). Since this function does not address a memory, the function code is transferred in the data word MBAddr. Any data required for the function is included in pMemoryAddr.

🐔 Inputs

VAR	INPUT				
	UnitID	:	UINT;		
	Quantity	:	WORD;		
	MBAddr	:	WORD;		
	cbLength	:	UINT;		
	pMemoryAddr	:	POINTER	ТО	BYTE;
	Execute	:	BOOL;		
	Timeout	:	TIME;		
END	VAR				

Name	Туре	Description	
UnitID	UINT	Modbus <u>station address [▶ 43]</u> (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address (see <u>UnitID [▶ 43]</u>)	
Quantity	WORD	Number of data words to be read or written for word- oriented Modbus functions. For bit-oriented Modbus functions, Quantity specifies the number of bits (inputs or coils).	
MBAddr	WORD	Modbus data address, from which the data are read from the end device (slave). This address is transferred unchanged to the slave and is interpreted there as data address. With the <i>Diagnostics</i> function (8) the function code (subfunction code) is transferred here.	
cbLength	UINT	Size of the data variable used for send or read actions in bytes. cbLength must be greater than or equal to the amount of data transferred as determined by Quantity. For word accesses, for example: [cbLength >= Quantity * 2]. cbLength can be calculated with SIZEOF(Modbus data).	
pMemoryAddr	BYTE	Memory address in the PLC, calculated with ADR (Modb data). For read actions, the read data are stored in the addressed variable. For send actions, the data are transferred from the addressed variable to the end device	
Execute	BOOL	Start signal. The action is triggered by a rising edge at the Execute input.	
Timeout	TIME	Timeout value for waiting for a response from the addressed slave.	

Outputs

```
VAR_OUTPUT

BUSY : BOOL;

Error : BOOL;

ErrorId : MODBUS_ERRORS;

cbRead : UINT;

END_VAR
```

Name	Туре	Description
Busy	BOOL	Indicates that the function block is active. <i>Busy</i> becomes TRUE with a rising edge at <i>Execute</i> and becomes FALSE again once the started action is completed. At any one time, only one action can be active.
Error	BOOL	Indicates that an error occurred during execution of an action.
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.
cbRead	UINT	Provides the number of read data bytes for a read action.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

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5.1.1.3 ModbusRtuMaster_KL6x22B

	ModbusRtuMaste	r_KL6x22B	
_	UnitID	BUSY	
_	Quantity	Error	
_	MBAddr	Errorld	
_	chl ength	chRead	
_	nMemoryAddr	00110000	
_	Everute		
_	Timeout		
	IIIIICOUL		

The function block ModbusRtuMaster_KL6x22B realizes a Modbus master, which communicates via a serial Bus Terminal KL6031 or KL6041. The function block <u>ModbusRtuMaster PcCOM [] 18]</u> is available for communication via a serial PC interface (COM port).



Hardware connection

The data structures required for the link with the communication port are included in the function block. On a PC, the assignment in the TwinCAT System Manager is analogous to the description in the <u>chapter Serial bus terminal</u> of the TF6340 TC3 Serial Communication documentation.

The function block is not called in its basic form, but individual actions of that block are used within a PLC program. Each Modbus function is implemented as an action.

Supported Modbus functions (actions)

ModbusMaster.ReadCoils
 Modbus function 1 = Read Coils

Reads binary outputs (coils) from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

ModbusMaster.ReadInputStatus
 Modbus function 2 = Read Input Status

Reads binary inputs from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

- ModbusMaster.ReadRegs Modbus function 3 = Read Holding Registers Reads data from a connected slave.
- ModbusMaster.ReadInputRegs

Modbus function 4 = *Read Input Registers*

Reads input registers from a connected slave.

ModbusMaster.WriteSingleCoil
 Modbus function 5 = Write Single Coil

Sends a binary output (coil) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteSingleRegister Modbus function 6 = Write Single Register

Sends a single data word to a connected slave

ModbusMaster.WriteMultipleCoils
 Modbus function 15 = Write Multiple Coils

Sends binary outputs (coils) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteRegs Modbus function 16 = Preset Multiple Registers

Sends data to a connected slave

ModbusMaster.Diagnostics

Modbus function 8 = *Diagnostics*

Sends a diagnostic request to the slave with a user-specified function code (subfunction code). Since this function does not address a memory, the function code is transferred in the data word MBAddr. Any data required for the function is included in pMemoryAddr.

🐔 Inputs	,
----------	---

/AR	INPUT					
	UnitID	:	UINT;			
	Quantity	:	WORD;			
	MBAddr	:	WORD;			
	cbLength	:	UINT;			
	pMemoryAddr	:	POINTER	ТО	BYTE;	
	Execute	:	BOOL;			
	Timeout	:	TIME;			
IND	VAR					

Name	Туре	Description
UnitID	UINT	Modbus <u>station address [▶ 43]</u> (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address (see <u>UnitID [▶ 43]</u>)
Quantity	WORD	Number of data words to be read or written for word- oriented Modbus functions. For bit-oriented Modbus functions, Quantity specifies the number of bits (inputs or coils).
MBAddr	WORD	Modbus data address, from which the data are read from the end device (slave). This address is transferred unchanged to the slave and is interpreted there as data address. With the <i>Diagnostics</i> function (8) the function code (subfunction code) is transferred here.
cbLength	UINT	Size of the data variable used for send or read actions in bytes. cbLength must be greater than or equal to the amount of data transferred as determined by Quantity. For word accesses, for example: [cbLength >= Quantity * 2]. cbLength can be calculated with SIZEOF(Modbus data).
pMemoryAddr	BYTE	Memory address in the PLC, calculated with ADR (Modbus data). For read actions, the read data are stored in the addressed variable. For send actions, the data are transferred from the addressed variable to the end device.
Execute	BOOL	Start signal. The action is triggered by a rising edge at the Execute input.
Timeout	TIME	Timeout value for waiting for a response from the addressed slave.

Outputs

```
VAR_OUTPUT
BUSY : BOOL;
Error : BOOL;
ErrorId : MODBUS_ERRORS;
cbRead : UINT;
END_VAR
```

Name	Туре	Description
Busy	BOOL	Indicates that the function block is active. <i>Busy</i> becomes TRUE with a rising edge at <i>Execute</i> and becomes FALSE again once the started action is completed. At any one time, only one action can be active.
Error	BOOL	Indicates that an error occurred during execution of an action.
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.
cbRead	UINT	Provides the number of read data bytes for a read action.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.2 ModbusRtuMasterV2_PcCOM

ModbusRtuMasterV2_PcCOM	
 UnitID BYTE BOOL BUSY -	_
 Quantity WORD BOOL Error -	_
 MBAddr WORD MODBUS_ERRORS ErrorId -	_
 cbLength UINT cbRead -	_
 pMemoryAddr POINTER TO BYTE	
 AuxQuantity WORD	
 AuxMBAddr WORD	
 AuxcbLength UINT	
 pAuxMemoryAddr POINTER TO BYTE	
 Execute BOOL	
 Timeout TIME	

The function block ModbusRtuMasterV2_PcCOM implements a Modbus master that communicates via a serial PC interface (COM port). Additional function blocks are available for communication via a serial bus terminal.



Hardware connection

The data structures required for the link with the communication port are included in the function block. They are displayed in the TwinCAT System Manager once the PLC program has been integrated and can be connected with a COM port. The procedure is analogous to the description in the <u>chapter Serial PC Interface</u> of the TF6340 TC3 Serial Communication documentation.

The function block is not called in its basic form, but individual actions of that block are used within a PLC program. Each Modbus function is implemented as an action.

Supported Modbus functions (actions)

• ModbusMaster.ReadCoils Modbus function 1 = Read Coils

Reads binary outputs (coils) from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

ModbusMaster.ReadInputStatus
 Modbus function 2 = Read Input Status

Reads binary inputs from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.ReadRegs Modbus function 3 = Read Holding Registers

Reads data from a connected slave.

ModbusMaster.WriteSingleCoil
 Modbus function 5 = Write Single Coil
 Sonda a binary output (apil) to a connected a

Sends a binary output (coil) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

ModbusMaster.WriteSingleRegister
 Modbus function 6 = Write Single Register

Sends a single data word to a connected slave

ModbusMaster.WriteMultipleCoils
 Modbus function 15 = Write Multiple Coils
 Conda binary outputs (coils) to a compacts

Sends binary outputs (coils) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteRegs Modbus function 16 = Preset Multiple Registers

Sends data to a connected slave

• ModbusMaster.Diagnostics Modbus function 8 = Diagnostics

Sends a diagnostic request to the slave with a user-specified function code (subfunction code). Since this function does not address a memory, the function code is transferred in the data word MBAddr. Any data required for the function is included in pMemoryAddr.

Supported Modbus functions (actions) of the MasterV2 function blocks

ModbusMaster.ReadWriteRegs

Modbus function 23 = Read/Write Multiple Registers

Sends the data specified via the Aux parameters to a connected slave and receives data from the slave at the same time. The received data is stored at the address specified by pMemoryAddr.

ModbusMaster.UserReadWrite

Universal user telegram

The Modbus function code is specified by the user in the first byte of specified data (pMemoryAddr). With this function the user is able to send a Modbus telegram with any function code. Any data received from the slave is stored at the address specified by pAuxMemoryAddr.

🔁 Inputs

```
VAR_INPUT
UnitID : BYTE;
Quantity : WORD;
MBAddr : WORD;
cbLength : UINT;
pMemoryAddr : POINTER TO BYTE;
AuxQuantity : WORD;
AuxMBAddr : WORD;
AuxcbLength : UINT;
pAuxMemoryAddr : POINTER TO BYTE;
Execute : BOOL;
Timeout : TIME;
END VAR
```

Name	Туре	Description
UnitID	UINT	Modbus <u>station address</u> $[\blacktriangleright 43]$ (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address (see <u>UnitID</u> $[\blacktriangleright 43]$)
Quantity	WORD	Number of data words to be read or written for word- oriented Modbus functions. For bit-oriented Modbus functions, Quantity specifies the number of bits (inputs or coils).
MBAddr	WORD	Modbus data address, from which the data are read from the end device (slave). This address is transferred unchanged to the slave and is interpreted there as data address. With the <i>Diagnostics</i> function (8) the function code (subfunction code) is transferred here.
cbLength	UINT	Size of the data variable used for send or read actions in bytes. cbLength must be greater than or equal to the amount of data transferred as determined by Quantity. For word accesses, for example: [cbLength >= Quantity * 2]. cbLength can be calculated with SIZEOF(Modbus data).
pMemoryAddr	BYTE	Memory address in the PLC, calculated with ADR (Modbus data). For read actions, the read data are stored in the addressed variable. For send actions, the data are transferred from the addressed variable to the end device.
AuxQuantity	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 26]</u>
AuxMBAddr	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 26]</u> .
AuxcbLength	UINT	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 26]</u>
pAuxMemoryAddr	BYTE	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite</u> [<u>26</u>]
Execute	BOOL	Start signal. The action is triggered by a rising edge at the Execute input.
Timeout	TIME	Timeout value for waiting for a response from the addressed slave.

Outputs

/AR	OUTPUT		
	BUSY	:	BOOL;
	Error	:	BOOL;
	ErrorId	:	MODBUS ERRORS;
	cbRead	:	UINT;
CMD	VAR		

Name	Туре	Description
Busy	BOOL	Indicates that the function block is active. <i>Busy</i> becomes TRUE with a rising edge at <i>Execute</i> and becomes FALSE again once the started action is completed. At any one time, only one action can be active.
Error	BOOL	Indicates that an error occurred during execution of an action.
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.
cbRead	UINT	Provides the number of read data bytes for a read action.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.3 ModbusRtuMasterV2_KL6x22B

	ModbusRtuMasterV2_KL6x22B	
_	UnitID BYTE BOOL BUSY	-
_	Quantity WORD BOOL Error	-
_	MBAddr WORD MODBUS_ERRORS ErrorId	-
_	cbLength UINT UINT cbRead	-
_	pMemoryAddr POINTER TO BYTE	
_	AuxQuantity WORD	
_	AuxMBAddr WORD	
_	AuxcbLength UINT	
_	pAuxMemoryAddr POINTER TO BYTE	
_	Execute BOOL	
_	Timeout TIME	

The function block ModbusRtuMasterV2_KL6x22B realizes a Modbus master, which communicates via a serial Bus Terminal KL6031 or KL6041. Serial EtherCAT Terminals with 22 bytes of data process image are also supported. The function block ModbusRtuMasterV2 PcCOM [> 25] is available for communication via a serial PC interface (COM port).

Hardware connection

The data structures required for the link with the communication port are included in the function block. On a PC, the assignment in the TwinCAT System Manager is analogous to the description in the <u>chapter Serial bus terminal</u> of the TF6340 TC3 Serial Communication documentation.

The function block is not called in its basic form, but individual actions of that block are used within a PLC program. Each Modbus function is implemented as an action.

Supported Modbus functions (actions)

 ModbusMaster.ReadCoils Modbus function 1 = Read Coils

Reads binary outputs (coils) from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

ModbusMaster.ReadInputStatus
 Modbus function 2 = Read Input Status

Reads binary inputs from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

- ModbusMaster.ReadRegs
 Modbus function 3 = Read Holding Registers
 - Reads data from a connected slave.
- ModbusMaster.ReadInputRegs Modbus function 4 = Read Input Registers Reads input registers from a connected slave.
- ModbusMaster.WriteSingleCoil Modbus function 5 = Write Single Coil

Sends a binary output (coil) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteSingleRegister Modbus function 6 = Write Single Register

Sends a single data word to a connected slave

ModbusMaster.WriteMultipleCoils
 Modbus function 15 = Mrite MultipleCoils

Modbus function 15 = *Write Multiple Coils*

Sends binary outputs (coils) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteRegs Modbus function 16 = Preset Multiple Registers

Sends data to a connected slave

• ModbusMaster.Diagnostics Modbus function 8 = Diagnostics

Sends a diagnostic request to the slave with a user-specified function code (subfunction code). Since this function does not address a memory, the function code is transferred in the data word MBAddr. Any data required for the function is included in pMemoryAddr.

Supported Modbus functions (actions) of the MasterV2 function blocks

ModbusMaster.ReadWriteRegs
 Modbus function 23 = Read/Write Multiple Registers

Sends the data specified via the Aux parameters to a connected slave and receives data from the slave at the same time. The received data is stored at the address specified by pMemoryAddr.

ModbusMaster.UserReadWrite

Universal user telegram

The Modbus function code is specified by the user in the first byte of specified data (pMemoryAddr). With this function the user is able to send a Modbus telegram with any function code. Any data received from the slave is stored at the address specified by pAuxMemoryAddr.

🐔 Inputs

VAR	INPUT						
	UnitID	:	BY	ΓE;			
	Quantity	:	WOI	RD;			
	MBAddr	:	WOI	RD;			
	cbLength	:	UII	TI;			
	pMemoryAddr	:	PO	INTER	ТО	BY	re;
	AuxQuantity		:	WORD	;		
	AuxMBAddr		:	WORD	;		
	AuxcbLength		:	UINT	;		
	pAuxMemoryAc	ldı	: :	POIN	FER	ТО	BYTE;
	Execute	:	BO	DL;			
	Timeout	:	TII	ME;			
END	VAR						

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Name	Туре	Description
UnitID	UINT	Modbus <u>station address</u> [▶ <u>43</u>] (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address (see <u>UnitID</u> [▶ <u>43</u>])
Quantity	WORD	Number of data words to be read or written for word- oriented Modbus functions. For bit-oriented Modbus functions, Quantity specifies the number of bits (inputs or coils).
MBAddr	WORD	Modbus data address, from which the data are read from the end device (slave). This address is transferred unchanged to the slave and is interpreted there as data address. With the <i>Diagnostics</i> function (8) the function code (subfunction code) is transferred here.
cbLength	UINT	Size of the data variable used for send or read actions in bytes. cbLength must be greater than or equal to the amount of data transferred as determined by Quantity. For word accesses, for example: [cbLength >= Quantity * 2]. cbLength can be calculated with SIZEOF(Modbus data).
pMemoryAddr	BYTE	Memory address in the PLC, calculated with ADR (Modbus data). For read actions, the read data are stored in the addressed variable. For send actions, the data are transferred from the addressed variable to the end device.
AuxQuantity	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite</u> [▶ 29]
AuxMBAddr	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 29]</u> .
AuxcbLength	UINT	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 29]</u>
pAuxMemoryAddr	BYTE	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 29]</u>
Execute	BOOL	Start signal. The action is triggered by a rising edge at the Execute input.
Timeout	TIME	Timeout value for waiting for a response from the addressed slave.

Outputs

/AR	OUTPUT		
	BUSY	:	BOOL;
	Error	:	BOOL;
	ErrorId	:	MODBUS ERRORS;
	cbRead	:	UINT;
CMD	VAR		

Name	Туре	Description
Busy	BOOL	Indicates that the function block is active. <i>Busy</i> becomes TRUE with a rising edge at <i>Execute</i> and becomes FALSE again once the started action is completed. At any one time, only one action can be active.
Error	BOOL	Indicates that an error occurred during execution of an action.
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.
cbRead	UINT	Provides the number of read data bytes for a read action.

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Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.4 ModbusRtuMasterV2_KL6x5B

ModbusRtuMasterV2_KL6x5B	
 UnitID BYTE BOOL BUSY	-
 Quantity WORD BOOL Error	-
 MBAddr WORD MODBUS_ERRORS ErrorId	⊢
 cbLength UINT CbRead	-
 pMemoryAddr POINTER TO BYTE	
 AuxQuantity WORD	
 AuxMBAddr WORD	
 AuxcbLength UINT	
 pAuxMemoryAddr POINTER TO BYTE	
 Execute BOOL	
 Timeout TIME	

The function block ModbusRtuMasterV2_KL6x5B realizes a Modbus master, which communicates via a serial Bus Terminal KL6001, KL6011 or KL6021. The function block ModbusRtuMasterV2_PcCOM [> 25] is available for communication via a serial PC interface (COM port).

Hardware connection

The data structures required for the link with the communication port are included in the function block. On a PC, the assignment in the TwinCAT System Manager is analogous to the description in the <u>chapter Serial bus terminal</u> of the TF6340 TC3 Serial Communication documentation.

The function block is not called in its basic form, but individual actions of that block are used within a PLC program. Each Modbus function is implemented as an action.

Supported Modbus functions (actions)

 ModbusMaster.ReadCoils Modbus function 1 = Read Coils

Reads binary outputs (coils) from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.ReadInputStatus Modbus function 2 = Read Input Status

Reads binary inputs from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

- ModbusMaster.ReadRegs
 Modbus function 3 = Read Holding Registers
 - Reads data from a connected slave.
- ModbusMaster.ReadInputRegs
 Modbus function 4 = Read Input Registers

Reads input registers from a connected slave.

• ModbusMaster.WriteSingleCoil Modbus function 5 = Write Single Coil

Sends a binary output (coil) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

ModbusMaster.WriteSingleRegister
 Modbus function 6 = Write Single Register
 Sends a single data word to a connected slave

ModbusMaster.WriteMultipleCoils

Modbus function 15 = *Write Multiple Coils*

Sends binary outputs (coils) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteRegs Modbus function 16 = Preset Multiple Registers

Sends data to a connected slave

• ModbusMaster.Diagnostics Modbus function 8 = Diagnostics

Sends a diagnostic request to the slave with a user-specified function code (subfunction code). Since this function does not address a memory, the function code is transferred in the data word MBAddr. Any data required for the function is included in pMemoryAddr.

Supported Modbus functions (actions) of the MasterV2 function blocks

ModbusMaster.ReadWriteRegs

Modbus function 23 = Read/Write Multiple Registers

Sends the data specified via the Aux parameters to a connected slave and receives data from the slave at the same time. The received data is stored at the address specified by pMemoryAddr.

ModbusMaster.UserReadWrite

Universal user telegram

The Modbus function code is specified by the user in the first byte of specified data (pMemoryAddr). With this function the user is able to send a Modbus telegram with any function code. Any data received from the slave is stored at the address specified by pAuxMemoryAddr.

🐔 Inputs

VAR	INPUT						
	UnitID	:	BY	ΓE;			
	Quantity	:	WOI	RD;			
	MBAddr	:	WOI	RD;			
	cbLength	:	UII	TI;			
	pMemoryAddr	:	PO	INTER	ТО	BY	ΓE;
	AuxQuantity		:	WORD	;		
	AuxMBAddr		:	WORD	;		
	AuxcbLength		:	UINT	;		
	pAuxMemoryAc	ldı	r :	POIN	FER	ТО	BYTE;
	Execute	:	BO	DL;			
	Timeout	:	TIT	ME;			
END	VAR						

Version: 1.4.2

Name	Туре	Description
UnitID	UINT	Modbus <u>station address [\blacktriangleright 43]</u> (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address (see <u>UnitID [\blacktriangleright 43]</u>)
Quantity	WORD	Number of data words to be read or written for word- oriented Modbus functions. For bit-oriented Modbus functions, Quantity specifies the number of bits (inputs or coils).
MBAddr	WORD	Modbus data address, from which the data are read from the end device (slave). This address is transferred unchanged to the slave and is interpreted there as data address. With the <i>Diagnostics</i> function (8) the function code (subfunction code) is transferred here.
cbLength	UINT	Size of the data variable used for send or read actions in bytes. cbLength must be greater than or equal to the amount of data transferred as determined by Quantity. For word accesses, for example: [cbLength >= Quantity * 2]. cbLength can be calculated with SIZEOF(Modbus data).
pMemoryAddr	BYTE	Memory address in the PLC, calculated with ADR (Modbus data). For read actions, the read data are stored in the addressed variable. For send actions, the data are transferred from the addressed variable to the end device.
AuxQuantity	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 32]</u>
AuxMBAddr	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶ 32]</u> .
AuxcbLength	UINT	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite[▶_32]</u>
pAuxMemoryAddr	BYTE	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶_32]</u>
Execute	BOOL	Start signal. The action is triggered by a rising edge at the Execute input.
Timeout	TIME	Timeout value for waiting for a response from the addressed slave.

Outputs

/AR	OUTPUT		
	BUSY	:	BOOL;
	Error	:	BOOL;
	ErrorId	:	MODBUS ERRORS;
	cbRead	:	UINT;
CMD	VAR		

Name	Туре	Description
Busy	BOOL	Indicates that the function block is active. <i>Busy</i> becomes TRUE with a rising edge at <i>Execute</i> and becomes FALSE again once the started action is completed. At any one time, only one action can be active.
Error	BOOL	Indicates that an error occurred during execution of an action.
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.
cbRead	UINT	Provides the number of read data bytes for a read action.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.5 ModbusRtuMasterV2_Generic

	ModbusRtuMasterV2_Generic
	UnitID BYTE BOOL BUSY
	Quantity WORD BOOL Error
	MBAddr WORD MODBUS_ERRORS ErrorId
	cbLength UINT cbRead
	pMemoryAddr POINTER TO BYTE
	AuxQuantity WORD
	AuxMBAddr WORD
	AuxcbLength UINT
_	pAuxMemoryAddr POINTER TO BYTE
_	Execute BOOL
	Timeout TIME
	RxBuffer ComBuffer
_	TxBuffer ComBuffer

The function block <code>ModbusRtuMasterV2_Generic</code> implements a Modbus master that communicates via various serial interfaces (COM port, virtual COM port, EtherCAT Terminals, ...).

Due to the hardware-independent nature of ModbusRtuMasterV2_Generic, its use is somewhat more complex than that of the hardware-dependent function blocks ModbusRtuMasterV2_PcCOM, ModbusRtuMasterV2_KL6x22B, ModbusRtuMasterV2_KL6x5B. All function blocks offer the same ModbusRTU functionality. However, the ModbusRtuMasterV2_Generic alone allows the use of virtual COM ports.

Connection to hardware via TF6340 TC3 Serial Communication (license required)

The data structures required to link to the communication port must be instantiated separately. The data structures of type ComBuffer present at this function block are data buffers for decoupling the hardware-dependent background communication. This background communication must be implemented via corresponding function blocks (SerialLineControl, SerialLineControlADS) of the <u>Tc2 SerialCom PLC library</u>, for which this PLC library must first be integrated in the program. The license for TF6340 TC3 Serial Communication is also required.

The function block is not called in its basic form, but individual actions of that block are used within a PLC program. Each Modbus function is implemented as an action.

Supported Modbus functions (actions)

 ModbusMaster.ReadCoils Modbus function 1 = Read Coils

Reads binary outputs (coils) from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.ReadInputStatus Modbus function 2 = Read Input Status

Reads binary inputs from a connected slave. The data is stored in compressed form (8 bits per byte) from the specified address pMemoryAddr.

- ModbusMaster.ReadRegs Modbus function 3 = Read Holding Registers Reads data from a connected slave.
- ModbusMaster.ReadInputRegs
 Modbus function 4 = Read Input Registers
 Reads input registers from a connected slave.

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 ModbusMaster.WriteSingleCoil Modbus function 5 = Write Single Coil

Sends a binary output (coil) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

• ModbusMaster.WriteSingleRegister Modbus function 6 = Write Single Register

Sends a single data word to a connected slave

• ModbusMaster.WriteMultipleCoils Modbus function 15 = Write Multiple Coils

Sends binary outputs (coils) to a connected slave. The data must be ready to send in compressed form (8 bits per byte) from the specified address pMemoryAddr.

- ModbusMaster.WriteRegs Modbus function 16 = *Preset Multiple Registers* Sends data to a connected slave
- ModbusMaster.Diagnostics Modbus function 8 = Diagnostics

Sends a diagnostic request to the slave with a user-specified function code (subfunction code). Since this function does not address a memory, the function code is transferred in the data word MBAddr. Any data required for the function is included in pMemoryAddr.

Supported Modbus functions (actions) of the MasterV2 function blocks

ModbusMaster.ReadWriteRegs

Modbus function 23 = Read/Write Multiple Registers

Sends the data specified via the Aux parameters to a connected slave and receives data from the slave at the same time. The received data is stored at the address specified by pMemoryAddr.

ModbusMaster.UserReadWrite

Universal user telegram

The Modbus function code is specified by the user in the first byte of specified data (pMemoryAddr). With this function the user is able to send a Modbus telegram with any function code. Any data received from the slave is stored at the address specified by pAuxMemoryAddr.

📌 Inputs

```
VAR_INPUT
UnitID : BYTE;
Quantity : WORD;
MBAddr : WORD;
cbLength : UINT;
pMemoryAddr : POINTER TO BYTE;
AuxQuantity : WORD;
AuxCbLength : UINT;
pAuxMemoryAddr : POINTER TO BYTE;
Execute : BOOL;
Timeout : TIME;
END_VAR
```

Name	Туре	Description
UnitID	UINT	Modbus <u>station address</u> [▶ <u>43</u>] (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address (see <u>UnitID</u> [▶ <u>43</u>])
Quantity	WORD	Number of data words to be read or written for word- oriented Modbus functions. For bit-oriented Modbus functions, Quantity specifies the number of bits (inputs or coils).
MBAddr	WORD	Modbus data address, from which the data are read from the end device (slave). This address is transferred unchanged to the slave and is interpreted there as data address. With the <i>Diagnostics</i> function (8) the function code (subfunction code) is transferred here.
cbLength	UINT	Size of the data variable used for send or read actions in bytes. cbLength must be greater than or equal to the amount of data transferred as determined by Quantity. For word accesses, for example: [cbLength >= Quantity * 2]. cbLength can be calculated with SIZEOF(Modbus data).
pMemoryAddr	BYTE	Memory address in the PLC, calculated with ADR (Modbus data). For read actions, the read data are stored in the addressed variable. For send actions, the data are transferred from the addressed variable to the end device.
AuxQuantity	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [▶_35]</u>
AuxMBAddr	WORD	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [> 35]</u> .
AuxcbLength	UINT	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [> 35]</u>
pAuxMemoryAddr	BYTE	Additional parameter which is only used for read/write functions, see <u>ReadWriteRegs/UserReadWrite [> 35]</u>
Execute	BOOL	Start signal. The action is triggered by a rising edge at the Execute input.
Timeout	TIME	Timeout value for waiting for a response from the addressed slave.

✓/IDPUTS/OUTPUTS

VAR	IN OUT		
_	RxBuffer	:	ComBuffer;
	TxBuffer	:	ComBuffer;
END	VAR		

Name	Туре	Description
TxBuffer	<u>ComBuffer (Tc2_SerialCom</u> <u>PLC library)</u>	Buffer with send data for the serial hardware being used. This data buffer is never directly written or read by the user, but only serves as a buffer for the communication blocks. The background communication must be realized via corresponding function blocks of the Tc2_SerialCom PLC library.
RxBuffer	<u>ComBuffer (Tc2_SerialCom</u> <u>PLC library)</u>	Buffer into which received data is placed. This data buffer is never directly written or read by the user, but only serves as a buffer for the communication blocks. The background communication must be realized via corresponding function blocks of the Tc2_SerialCom PLC library.

Outputs

/AR_	OUTPUT			
	BUSY	:	BOOL;	
	Error	:	BOOL;	
	ErrorId	:	MODBUS	ERRORS;
	cbRead	:	UINT;	_
END	VAR			

Name	Туре	Description
Busy	BOOL	Indicates that the function block is active. <i>Busy</i> becomes TRUE with a rising edge at <i>Execute</i> and becomes FALSE again once the started action is completed. At any one time, only one action can be active.
Error	BOOL	Indicates that an error occurred during execution of an action.
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.
cbRead	UINT	Provides the number of read data bytes for a read action.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.4024.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU (>= v3.5.6.0)

5.1.6 ModbusRtuSlave_PcCOM



The function block ModbusRtuSlave_PcCOM implements a Modbus slave that communicates via a serial PC interface (COM port). The function block <u>ModbusRtuSlave KL6x5B [) 40]</u> is available for communication via a serial Bus Terminal KL6001, KL6011 or KL6021.

The function block is passive until it receives telegrams from a connected Modbus master. A sample program explains the operating principle.



Hardware connection

The data structures required for the link with the communication port are included in the function block. They are displayed in the TwinCAT System Manager once the PLC program has been integrated and can be connected with a COM port. The procedure is analogous to the description in the <u>chapter Serial PC Interface</u> of the TF6340 TC3 Serial Communication documentation.

🐔 Inputs

```
VAR_INPUT
UnitID : UINT;
AdrInputs : POINTER TO BYTE; (* Pointer to the Modbus input area *)
SizeInputBytes : UINT;
AdrOutputs : POINTER TO BYTE; (* Pointer to the Modbus output area *)
SizeOutputBytes : UINT;
AdrMemory : POINTER TO BYTE; (* Pointer to the Modbus memory area *)
SizeMemoryBytes : UINT;
END VAR
```

Name	Туре	Description
UnitID	UINT	Modbus <u>station address [▶ 43]</u> (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address.
AdrInputs	BYTE	Start address of the <u>Modbus input area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (input variable).
SizeInputBytes	UINT	Size of the Modbus input array in bytes. The size can be calculated with SIZEOF (input variable).
AdrOutputs	BYTE	Start address of the <u>Modbus output area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (output variable).
SizeOutputBytes	UINT	Size of the Modbus output array in bytes. The size can be calculated with SIZEOF (output variable).
AdrMemory	BYTE	Start address of the <u>Modbus memory area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (memory variable).
SizeMemoryBytes	UINT	Size of the Modbus memory array in bytes. The size can be calculated with SIZEOF (memory variable).

Outputs

```
VAR_OUTPUT
ErrorId : MODBUS_ERRORS;
END VAR
```

Name	Туре	Description
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.7 ModbusRtuSlave_KL6x22B

	ModbusRtuSlave_KL6x22B
_	UnitID UINT Modbus_ERRORS ErrorId
	AdrInputs POINTER TO BYTE
	SizeInputBytes UINT
	AdrOutputs POINTER TO BYTE
	SizeOutputBytes UINT
	AdrMemory POINTER TO BYTE
_	SizeMemoryBytes UINT

The function block ModbusRtuSlave_KL6x22B realizes a Modbus slave, which communicates via a serial Bus Terminal KL6031 or KL6041. Serial EtherCAT Terminals with 22 bytes of data process image are also supported. The function block ModbusRtuSlave PcCOM [▶ 37] is available for communication via a serial PC interface (COM port).

The function block is passive until it receives telegrams from a connected Modbus master.

BECKHOFF

i

Hardware connection

The data structures required for the link with the communication port are included in the function block. On a PC, the assignment in the TwinCAT System Manager is analogous to the description in the <u>chapter Serial bus terminal</u> of the TF6340 TC3 Serial Communication documentation.

🕫 Inputs

VAR	INPUT												
	UnitID	:	UINT;										
	AdrInputs	:	POINTER	TO	BYTE;	(*	Pointer	to	the	Modbus	input a	area *)
	SizeInputBytes	:	UINT;										
	AdrOutputs	:	POINTER	TO	BYTE;	(*	Pointer	to	the	Modbus	output	area	*)
	SizeOutputBytes	:	UINT;										
	AdrMemory	:	POINTER	TO	BYTE;	(*	Pointer	to	the	Modbus	memory	area	*)
	SizeMemoryBytes	:	UINT;										
END	VAR												

Name	Туре	Description
UnitID	UINT	Modbus <u>station address</u> [▶ <u>43</u>] (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address.
AdrInputs	BYTE	Start address of the <u>Modbus input area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (input variable).
SizeInputBytes	UINT	Size of the Modbus input array in bytes. The size can be calculated with SIZEOF (input variable).
AdrOutputs	BYTE	Start address of the <u>Modbus output area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (output variable).
SizeOutputBytes	UINT	Size of the Modbus output array in bytes. The size can be calculated with SIZEOF (output variable).
AdrMemory	BYTE	Start address of the <u>Modbus memory area [15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (memory variable).
SizeMemoryBytes	UINT	Size of the Modbus memory array in bytes. The size can be calculated with SIZEOF (memory variable).

Outputs

VAR_OUTPUT ErrorId : MODBUS_ERRORS; END_VAR

Name	Туре	Description
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶_44]</u> in the event of disturbed or faulty communication.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.8 ModbusRtuSlave_KL6x5B

	ModbusRtuSlave_KL6x5B						
_	UnitID UINT Modbus_ERRORS ErrorId	-					
	AdrInputs POINTER TO BYTE						
	SizeInputBytes UINT						
	AdrOutputs POINTER TO BYTE						
	SizeOutputBytes UINT						
	AdrMemory POINTER TO BYTE						
_	SizeMemoryBytes UINT						

The function block ModbusRTUslave_KL6x5B realizes a Modbus slave, which communicates via a serial Bus Terminal KL6001, KL6011 or KL6021. The function block <u>ModbusRtuSlave PcCOM [>37]</u> is available for communication via a serial PC interface (COM port).

The function block is passive until it receives telegrams from a connected Modbus master.



Hardware connection

The data structures required for the link with the communication port are included in the function block. On a PC, the assignment in the TwinCAT System Manager is analogous to the description in the <u>chapter Serial bus terminal</u> of the TF6340 TC3 Serial Communication documentation.

🐔 Inputs

```
VAR_INPUT
UnitID : UINT;
AdrInputs : POINTER TO BYTE; (* Pointer to the Modbus input area *)
SizeInputBytes : UINT;
AdrOutputs : POINTER TO BYTE; (* Pointer to the Modbus output area *)
SizeOutputBytes : UINT;
AdrMemory : POINTER TO BYTE; (* Pointer to the Modbus memory area *)
SizeMemoryBytes : UINT;
END VAR
```

Name	Туре	Description
UnitID	UINT	Modbus <u>station address [) 43]</u> (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address.
AdrInputs	BYTE	Start address of the <u>Modbus input area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (input variable).
SizeInputBytes	UINT	Size of the Modbus input array in bytes. The size can be calculated with SIZEOF (input variable).
AdrOutputs	BYTE	Start address of the <u>Modbus output area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (output variable).
SizeOutputBytes	UINT	Size of the Modbus output array in bytes. The size can be calculated with SIZEOF (output variable).
AdrMemory	BYTE	Start address of the <u>Modbus memory area [\blacktriangleright 15]. The data area is usually declared as a PLC array, and the address can be calculated with ADR (memory variable).</u>
SizeMemoryBytes	UINT	Size of the Modbus memory array in bytes. The size can be calculated with SIZEOF (memory variable).

BECKHOFF

Outputs

VAR_OUTPUT ErrorId : MODBUS_ERRORS; END_VAR

Name	Туре	Description
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.1.9 ModbusRtuSlave_Generic

	ModbusRtuSlave_Ge	neric
_	UnitID UINT	Modbus_ERRORS ErrorId
	AdrInputs POINTER TO BYTE	
	SizeInputBytes UINT	
	AdrOutputs POINTER TO BYTE	
	SizeOutputBytes UINT	
	AdrMemory POINTER TO BYTE	
	SizeMemoryBytes UINT	
	RxBuffer ComBuffer	
_	TxBuffer ComBuffer	

The function block ModbusRtuSlave_Generic implements a Modbus slave that communicates via various serial interfaces (COM port, virtual COM port, EtherCAT Terminals, ...).

Due to the hardware-independent nature of ModbusRtuSlave_Generic, its use is somewhat more complex than that of the hardware-dependent function blocks ModbusRtuSlave_PcCOM, ModbusRtuSlave_KL6x22B, ModbusRtuSlave_KL6x5B. All function blocks offer the same ModbusRTU functionality. However, the ModbusRtuSlave_Generic alone allows the use of virtual COM ports.

The function block is passive until it receives telegrams from a connected Modbus master. A sample program explains the operating principle.



Connection to hardware via TF6340 TC3 Serial Communication (license required)

The data structures required to link to the communication port must be instantiated separately. The data structures of type ComBuffer present at this function block are data buffers for decoupling the hardware-dependent background communication. This background communication must be implemented via corresponding function blocks (SerialLineControl, SerialLineControlADS) of the <u>Tc2 SerialCom PLC library</u>, for which this PLC library must first be integrated in the program. The license for TF6340 TC3 Serial Communication is also required.

📌 Inputs

VAR_	_INPUT												
	UnitID	:	UINT;										
	AdrInputs	:	POINTER	TO	BYTE;	(*	Pointer	to	the	Modbus	input	area	*)
	SizeInputBytes	:	UINT;										
	AdrOutputs	:	POINTER	TO	BYTE;	(*	Pointer	to	the	Modbus	output	area	*)
	SizeOutputBytes	:	UINT;										
	AdrMemory	:	POINTER	TO	BYTE;	(*	Pointer	to	the	Modbus	memory	area	*)
	SizeMemoryBytes	:	UINT;										
END	VAR												

Name	Туре	Description
UnitID	UINT	Modbus <u>station address [▶ 43]</u> (1247). The Modbus slave will only answer if it receives telegrams containing its own station address. Optionally, collective addresses can be used for replying to any requests. Address 0 is reserved for broadcast telegrams and is therefore not a valid station address.
AdrInputs	BYTE	Start address of the <u>Modbus input area [\blacktriangleright 15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (input variable).
SizeInputBytes	UINT	Size of the Modbus input array in bytes. The size can be calculated with SIZEOF (input variable).
AdrOutputs	BYTE	Start address of the <u>Modbus output area</u> [\blacktriangleright <u>15</u>]. The data area is usually declared as a PLC array, and the address can be calculated with ADR (output variable).
SizeOutputBytes	UINT	Size of the Modbus output array in bytes. The size can be calculated with SIZEOF (output variable).
AdrMemory	BYTE	Start address of the <u>Modbus memory area</u> [▶ <u>15]</u> . The data area is usually declared as a PLC array, and the address can be calculated with ADR (memory variable).
SizeMemoryBytes	UINT	Size of the Modbus memory array in bytes. The size can be calculated with SIZEOF (memory variable).

✓/Imputs/outputs

VAR_IN_OUT RxBuffer : ComBuffer; TxBuffer : ComBuffer; END_VAR

Name	Туре	Description
TxBuffer	<u>ComBuffer (Tc2_SerialCom</u> <u>PLC library)</u>	Buffer with send data for the serial hardware being used. This data buffer is never directly written or read by the user, but only serves as a buffer for the communication blocks. The background communication must be realized via corresponding function blocks of the Tc2_SerialCom PLC library.
RxBuffer	<u>ComBuffer (Tc2_SerialCom</u> <u>PLC library)</u>	Buffer into which received data is placed. This data buffer is never directly written or read by the user, but only serves as a buffer for the communication blocks. The background communication must be realized via corresponding function blocks of the Tc2_SerialCom PLC library.

Outputs

```
VAR_OUTPUT
ErrorId : MODBUS_ERRORS;
END_VAR
```

Name	Туре	Description
Errorld	MODBUS_ERRORS	Indicates an <u>error number [▶ 44]</u> in the event of disturbed or faulty communication.

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.4024.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU (>= v3.5.6.0)

5.2 Datatypes

5.2.1 Modbus station address

Modbus defines valid station addresses in the range 1 to 247. A Modbus slave only responds to telegrams that contain its own address. Address 0 is not a valid station address. It is used for broadcast telegrams to all stations. These are not answered. Addresses 248 to 255 are reserved.

The Tc2_ModbusRTU library defines further collective addresses. This enables a station to respond to several addresses.

```
TYPE MODBUS_UNITID :

(

MODBUS_UNITID_BROADCAST := 0,

MODBUS_UNITID_ALLVALID := 256, (* response on address 1..247 *)

MODBUS_UNITID_ALLBUTBROADCAST := 257, (* response on address 1..255 *)

MODBUS_UNITID_ALL := 258 (* response on address 0..255 *)

);

END TYPE
```

Requirements

Development environment	Target platform	PLC libraries to include
TwinCAT v3.1.0	PC or CX (x86, x64, ARM)	Tc2_ModbusRTU

5.3 Global Constants

5.3.1 Global_Version

All libraries have a certain version. The version is indicated in the PLC library repository, for example. A global constant contains the information about the library version:

```
VAR_GLOBAL CONSTANT
stLibVersion_Tc2_Modbus_RTU : ST_LibVersion;
END VAR
```

To check whether the version you have is the version you need, use the function F_CmpLibVersion (defined in the Tc2_System PLC library).



All other options for comparing library versions, which you may know from TwinCAT 2, are outdated!

6 Appendix

6.1 Modbus RTU Error Codes

```
TYPE MODBUS ERRORS :
(* Modbus communication errors *)
MODBUSERROR NO ERROR, (* 0 *)
MODBUSERROR ILLEGAL FUNCTION, (* 1 *)
MODBUSERROR ILLEGAL DATA ADDRESS, (* 2 *)
MODBUSERROR_ILLEGAL_DATA_VALUE, (* 3 *)
MODBUSERROR_SLAVE_DEVICE_FAILURE, (* 4 *)
MODBUSERROR_ACKNOWLEDGE, (* 5 *)
MODBUSERROR_SLAVE_DEVICE_BUSY, (* 6 *)
MODBUSERROR_NEGATIVE_ACKNOWLEDGE, (* 7 *)
MODBUSERROR_MEMORY_PARITY, (* 8 *)
MODBUSERROR_GATEWAY_PATH_UNAVAILABLE, (* A *)
MODBUSERROR GATEWAY TARGET DEVICE FAILED TO RESPOND, (* B *)
(* additional Modbus error definitions *)
MODBUSERROR_CHARREC_TIMEOUT := 16#20, (* 20 hex *)
MODBUSERROR_ILLEGAL_DATA_SIZE, (* 21 hex *)
MODBUSERROR_ILLEGAL_DEVICE_ADDRESS, (* 22 hex *)
MODBUSERROR_ILLEGAL_DESTINATION_ADDRESS, (* 23 hex *)
MODBUSERROR_ILLEGAL_DESTINATION_SIZE, (* 24 hex *)
MODBUSERROR_NO_RESPONSE, (* 25 hex *)
(* Low level communication errors *)
MODBUSERROR_TXBUFFOVERRUN := 102, (* 102 *)
MODBUSERROR_SENDTIMEOUT := 103, (* 103 *)
MODBUSERROR DATASIZEOVERRUN := 107, (* 107 *)
MODBUSERROR_STRINGOVERRUN := 110, (* 110 *)
MODBUSERROR_INVALIDPOINTER := 120, (* 120 *)
MODBUSERROR CRC := 150, (* 150 *)
(* High level PLC errors *)
MODBUSERROR INVALIDMEMORYADDRESS := 232, (* 232 *)
```

MODBUSERROR TRANSMITBUFFERTOOSMALL (* 233 *)

); END TYPE

More Information: www.beckhoff.com/tf6255

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