Magelis XBT G & XBT GT
Modbus (RTU) driver

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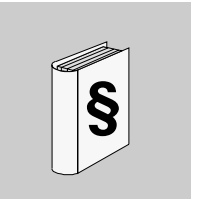
Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, 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 an imminently hazardous situation, which, if not avoided, **will result** in death, serious injury, or equipment damage.

⚠ WARNING

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

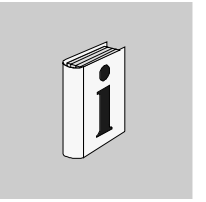
⚠ CAUTION

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

PLEASE NOTE

Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

About the Book



At a Glance

Document Scope This documentation presents Modbus (RTU) driver for Magelis XBT G & XBT GT.

Related Documents

Title of Documentation	Reference Number
Vijeo Designer User manual	Included in the Vijeo Designer CDROM
Vijeo Designer Tutorial	Included in the Vijeo Designer CDROM
Magelis XBT G Modbus TCP/IP driver	Included in the Vijeo Designer CDROM
Magelis XBT G Modbus Plus driver	Included in the Vijeo Designer CDROM

Product Related Warnings

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link. *
- Each implementation of Magelis XBT G and XBT GT must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

* 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".

User Comments

We welcome your comments about this document. You can reach us by e-mail at techpub@schneider-electric.com

Modbus (RTU) Driver

1

At a Glance

Subject of this chapter

This chapter explains how to connect the target machine with Modbus RTU equipment. For information about how to use the Vijeo-Designer software, please refer to the Vijeo-Designer Online Help.

The types of target machines that are compatible with Vijeo-Designer depends on the version of Vijeo-Designer. For information about the compatibility of target machines, please refer to the Vijeo-Designer Online or User Manual help.

Note: target machines mean Magelis XBT G/XBT GT products.

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
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Consecutive Equipment Addresses	26
Environment Setup	28
I/O Manager Configuration	30
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Equipment Configuration	33
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System Structure

Overview

The following table describes tested system configurations for connecting target machines with Modbus RTU equipment.

To view a cable connection diagram for a particular communication format, see the Cable diagrams section (See *Cable Diagrams, p. 14*).

Connection XBT G

The following table describes the basic system setup for connecting the target machine to Modbus RTU equipment.

Protocol	CPU	Link I/F	Comm.Format	XBT G Connector	Diagram
Modbus RTU	Twido (Slave address =1)	Modbus Slave auxiliary terminal port	RS-485, 19200, Data 8, parity none, Stop bit 1,	Com1 D-Sub25 + XBT ZG999	Cable Diagram 1
				Com2 D-Sub 9	Cable diagram 3
	Twido (Slave address =1 to 247)	TWDNOZ485D TWDNAC485D	RS-485	Com1 SUb-D25 + XBT ZG999	Cable diagram 1
				Com2 D-Sub 9	Cable diagram 3
	TSX37 Micro	Modbus Slave auxiliary terminal port	RS-485	Com1 SUb-D25 + XBT ZG999	Cable Diagram 5
	Quantum	CPU'S Modbus port Sub-D9	RS-232C	Com1 SUb-D25 + XBT ZG999	Cable Diagram 2
	Momentum	CPU's Modbus port RJ45	RS-232C	Com1 SUb-D25 + XBT ZG999	Cable Diagram 2
	TSX57 Premium	SCY2160	RS-485	Com1 SUb-D25 + XBT ZG999	Cable Diagram 6
	TESys Zelio (SR3MBU01BD)	RJ45	RS-485	Com1 SUb-D25 + XBT ZG999	Cable Diagram 8
	Advantys STB	HE connector on NIM	RS-232C	Com2 Sub-D9	Cable Diagram 7
	Any Modbus Equipment	TSX SCA 62 Socket subscriber	RS-485	Com1 SUb-D25 + XBT ZG999	Cable Diagram 4
		Modelbus Hub LU9GC3	RS-485	Com1 SUb-D25 + XBT ZG999	Cable Diagram 8

Note:
- To connect XBT G/XBT GT to TSX-SCG116, use XBT ZG999 + XBT Z928
- To connect XBT G/XBT GT to TSX17, use XBT ZG999 + XBT Z917
- To connect XBT G/XBT GT to V4 CPU through TSXLES64/74, use XBT ZG999 + XBT Z948 on HE13/14

Connection XBT GT1000 series

The following table describes the basic system setup for connecting the target machine to Modbus RTU equipment.

Protocol	CPU	Link I/F	Comm.Format	XBT GT Connector	Diagram
Modbus RTU	Twido	Modbus Slave auxiliary terminal port TWDNOZ485D TWDNAC485D	RS-485	Com1 RJ45	Cable Diagram 10
	Micro	Modbus Slave auxiliary terminal port	RS-485	Com1 RJ45	Cable Diagram 10
	Momentum	CPU's Modbus port	RS-232C	Com1 RJ45 + XBT ZG939	Cable diagram 16
	TSX57 PremiumTSX57 Premium UNITY	SCY2160 D-Sub25	RS-485	Com1 RJ45 + XBT ZG939	Cable diagram 14
		SCY2160 SCP114	RS-485	Com1 RJ45	Cable Diagram 15
	TESys Zelio (SR3 MBU01BD)ATV	RJ45	RS-485	Com1 RJ45	Cable Diagram 12
	Advantys	HE13	RS-232C	Com1 RJ45	Cable Diagram 17
	Any Modbus Equipment	Modbus HUB Modbus-T SCA62 Socket Subscriber	RS-485	Com1 RJ45	Cable Diagram 11 Cable Diagram 15 Cable Diagram 13

Connection XBT GT2000 series

The following table describes the basic system setup for connecting the target machine to Modbus RTU equipment.

Protocol	CPU	Link I/F	Comm. Format	XBT GT Connector	Diagram
Modbus RTU	Twido	Modbus Slave auxiliary terminal port TWDNOZ485D TWDNAC485D	RS-485	Com2 RJ45	Cable Diagram 10
				Com1 D-Sub-D9 + XBT ZG909	Cable diagram 18
	Micro	Modbus Slave auxiliary terminal port	RS-485	Com2 RJ45	Cable diagram 25
				Com1 D-Sub-D9 + XBT ZG909	Cable diagram 26
	Quantum	CPU'S Modbus port Sub-D9	RS-232C	Com1 D-Sub-D9 + XBT ZG919	Cable Diagram 19
	Momentum	CPU's Modbus port	RS-232C	Com1 D-Sub-D9 + XBT ZG999	Cable Diagram 21
	Premium	SCY2160	RS-485	Com2 RJ45 + XBT ZG939	Cable Diagram 14
				Com1 D-Sub-D9 +XBT ZG909	Cable Diagram 22
	TESys Zelio (SR3MBU01BD)	RJ45	RS-485	Com2 RJ45	Cable Diagram 12
				Com1 D-Sub9 + XBT ZG909	Cable Diagram 20
	Advantys	HE13	RS-232C	Com1 D-Sub-D9	Cable Diagram 24
	Any Modbus Equipment	Modbus HUB TSXPACC01 Socket subscriber Modbus-T	RS-485	COM2 RJ45	Cable Diagram 11 Cable diagram 15 Cable diagram 13
		TSXSCA62 Socket subscriber	RS-485	Com1 D-Sub-D9 + XBT ZG909	Cable Diagram 23

Cable Diagrams

Overview

Schneider Electric recommends using the connection schemes in the following diagrams, as specified in the preceding connection tables.

- Ground the equipment and the terminal according to your country's applicable standard. For details, refer to the equipment manual.

Diagram 1 XBT G series

RS 485

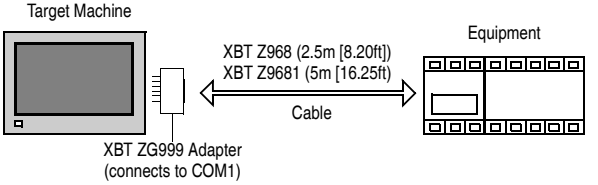


Diagram 2 XBT G series

RS 232C

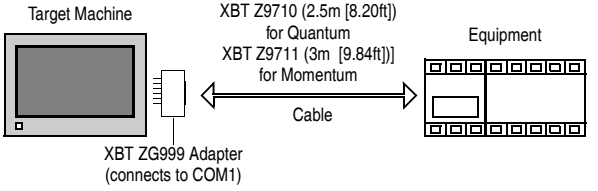


Diagram 3 XBT G series

RS 485

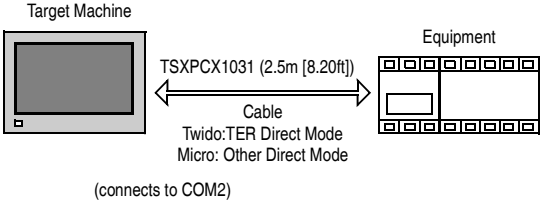


Diagram 4 XBT G series RS 485

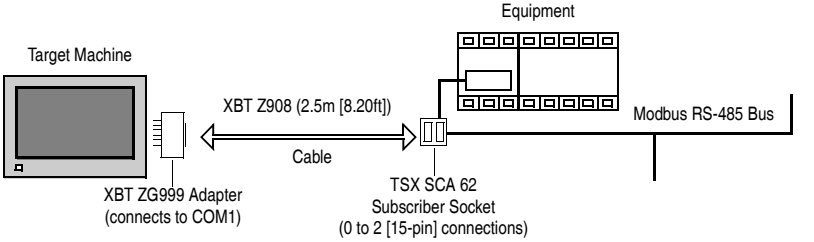


Diagram 5 XBT G series RS 485

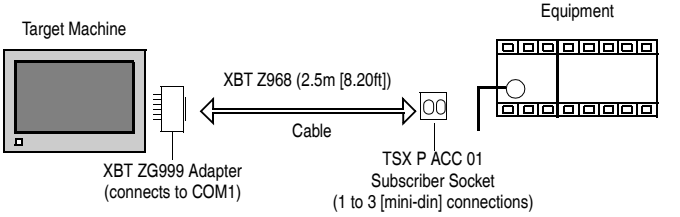


Diagram 6 XBT G series RS 485

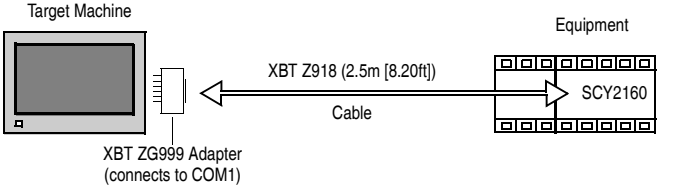


Diagram 7 XBT G series RS 232C

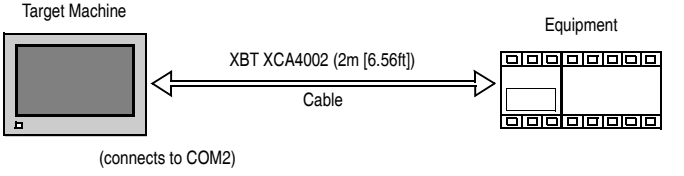
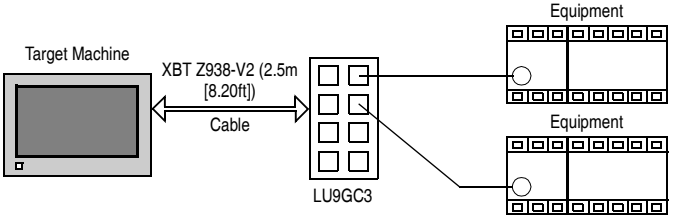


Diagram 8 XBT G series



Note: For point to point connection, connect the XBT Z to the RJ45 equipment's connector. Diagram 8 is using RS485 2 Wires bus. For the XBT Z938-V2, make sure that this exact reference is written on the cable.

Diagram 10 XBT GT series

RS 485

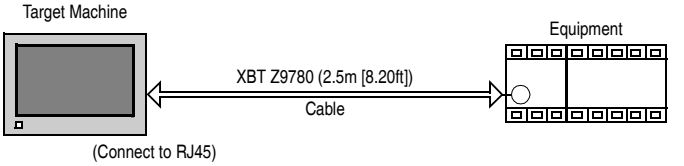


Diagram 11 XBT GT series

RS 485

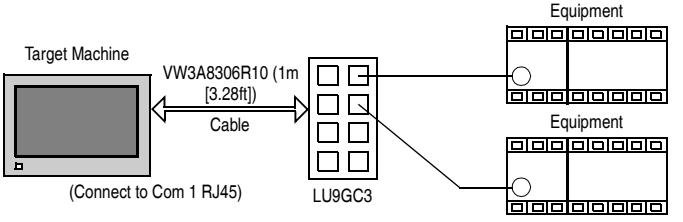


Diagram 12 XBT GT series

RS 485

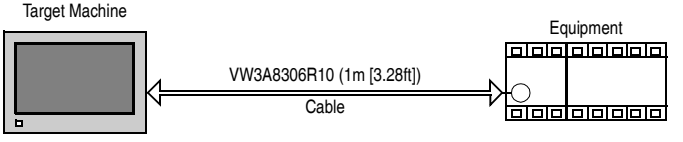


Diagram 13
XBT GT series

RS 485

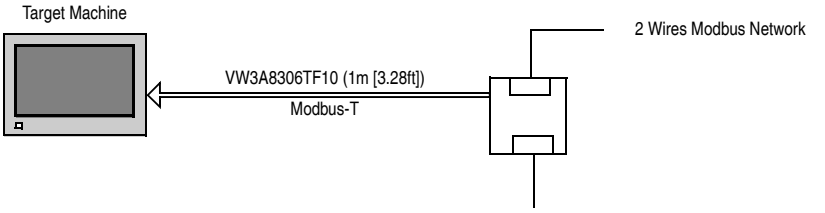


Diagram 14
XBT GT series

RS 485

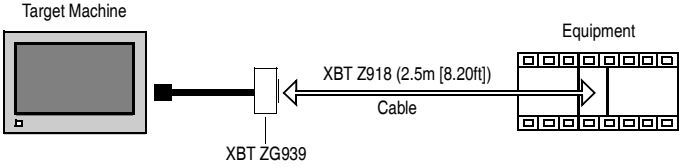


Diagram 15
XBT GT series

RS 485

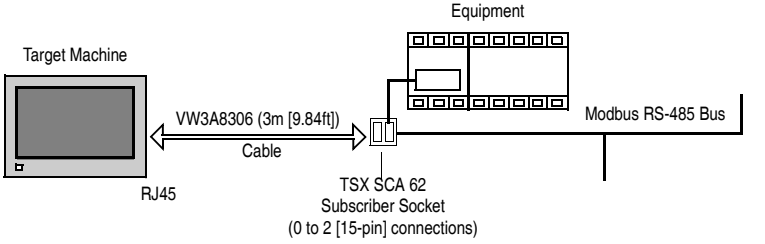


Diagram 16
XBT GT series

RS 485

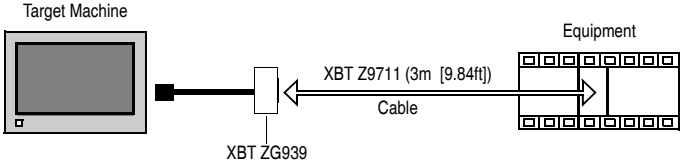


Diagram 17
XBT GT series

RS 485

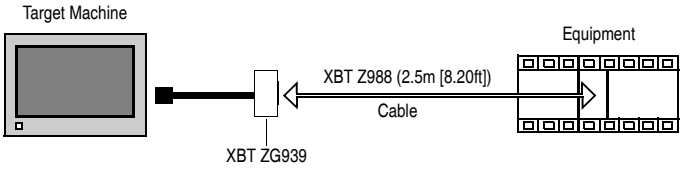


Diagram 18
XBT GT series

RS 485

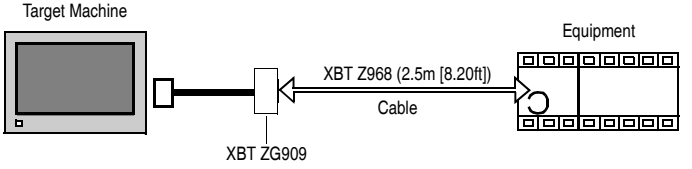


Diagram 19
XBT GT series

RS 485

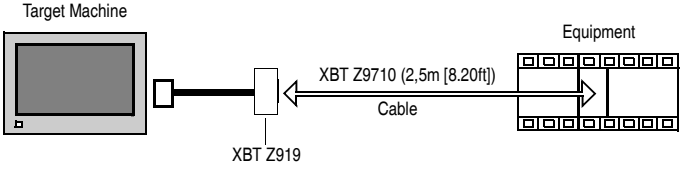


Diagram 20
XBT GT series

RS 485

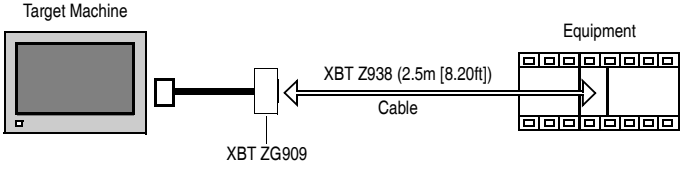


Diagram 21
XBT GT series

RS 485

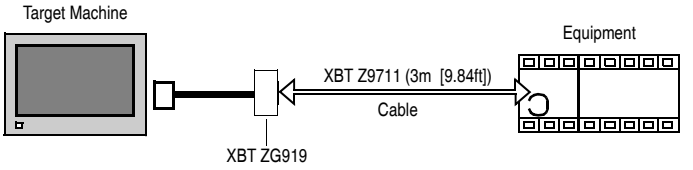


Diagram 22
XBT GT series

RS 485

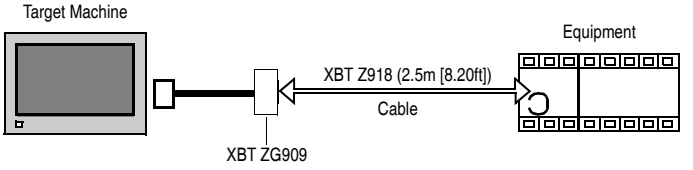


Diagram 23
XBT GT series

RS 485

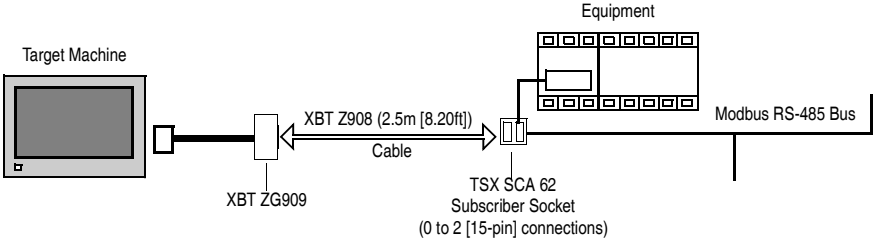


Diagram 24
XBT GT series

RS 485

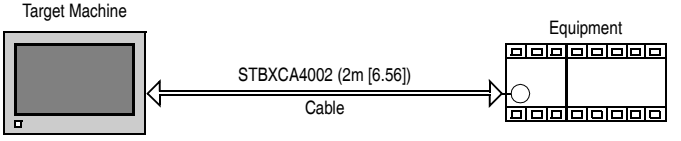


Diagram 25
XBT TG series

RS 485

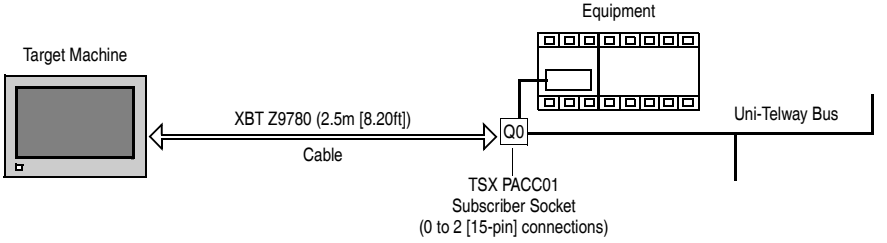
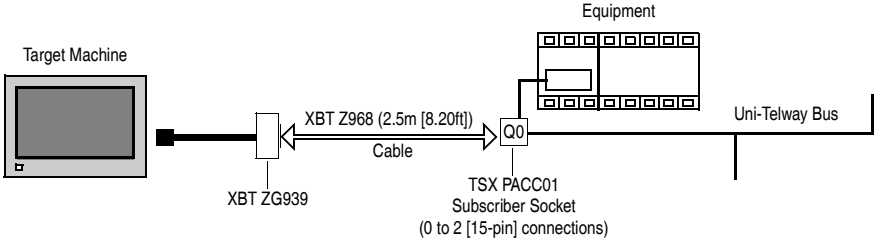


Diagram 26
XBT GT series

RS 485



Supported Equipment Variable Addresses

Overview

The following table lists the equipment variable address ranges you can enter from the **Equipment Address keypad**.

For actual equipment variable address ranges supported by the equipment, refer to the corresponding manual.

Note: if you have selected the IEC61131 check box in the Equipment Configuration window (See *Equipment Configuration, p. 33*) you could use the IEC syntax to access variables. If not, you could use the State RAM syntax.

IEC Equipment variable address range

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Consider possible conflicts between the XBT G/XBT GT and PLC program attempting to simultaneously write the same register, and design your system to avoid these conflicting write operations.
Do not allow your programs or other devices to write 16-bit word values to registers being accessed in a bitwise manner.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

The following table lists the equipment variable address range if you have selected the IEC 61131 check box.

Variable	Bit Address	Word Address	Note
%Mi	i=0 to 65535	--	Read/Write access.
%MWi:Xj	i=0 to 65535 j=0 to 15	--	j is a bit index with the following convention: 0 for the least significant bit and 15 for the most significant bit. Read/Write access. When you write to one of these bit addresses, the target machine reads the entire word, sets the defined bit, then returns the new word address to the PLC. If the ladder program writes data to this word value during the bit read/write process, the resulting data may be incorrect.
%MWi	--	i=0 to 65535	Read/Write access.
%MDi	--	i=0 to 65534	Read/Write access. To fit with equipment variable coding, the most significant byte could be chosen by the software (See *Equipment Configuration, p. 33*).
%MFi	--	i=0 to 65534	

Non IEC Equipment variable address range

The following table lists the equipment variable address range if you haven't selected the IEC 61131 check box.

Variable	Bit Address	Word Address	Note
Coils (C)	00001-65536	--	Read/Write access.
Discrete Inputs	10001-165536	--	Read-only
Single word Input Registers	30001,0-65536,15	30001-365536	Read-only
Single word Holding Registers	40001,0-465536,15	40001-465536	Read/Write access. When you write to one of these bit addresses, the target machine reads the entire word address, sets the defined bit, then returns the new word address to the PLC. If the ladder program writes data to this word address during the bit read/write process, the resulting data may be incorrect.
Double word Input Registers	30001,0-65536,15	30001-365535	Read-only To fit with equipment variable coding, the most significant byte could be chosen by the software (See *Equipment Configuration, p. 33*).
Double word Holding Registers	40001,0-465536,15	40001-465535	Rea/Write access. To fit with equipment variable coding, the most significant byte could be chosen by the software (See *Equipment Configuration, p. 33*).

Variable mapping

⚠ CAUTION

INVALID DISPLAY VALUES

If the word byte order or the double word word order set in the XBT G/XBT GT are different than the equipment order, the displayed values on the XBT G/XB GT will be wrong.
Select for the XBT G/XBT GT the same configuration than the equipment.

Failure to follow this instruction can result in injury or equipment damage.

The word (16-bit) is managed as follows:

- least significant = byte n
- most significant = byte n + 1

(Check that the connected equipment uses the same format).

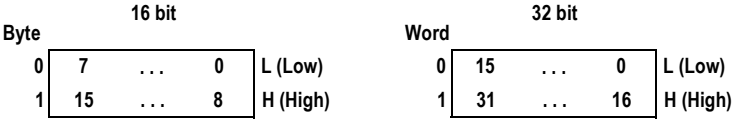
The double word word (32-bit) is managed as follows:

If the **high word first Equipment Configuration** (See *Equipment Configuration, p. 33*) option is selected:

- most significant = word n
- least significant = word n + 1

(Check that the connected equipment uses the same format.)

16-bit and 32-bit data, High and Low example.



Note: If **Low word first Equipment Configuration** (See *Equipment Configuration, p. 33*) is selected, the most significant word and the least significant word are inverted. For example to be consistent with Premium PLC format use the value **Low word first**.

The STRING is managed as follows:

Inside PLCs a STRING is usually an array of words for which every word contains two characters (one character per byte). For example the **HELLO!** string representation is the following:

Word order	Most significant byte	Least significant byte
First word	E	H
Second word	L	L
Third word	!	O

- If **Low byte first Equipment Configuration** (See *Equipment Configuration, p. 33*) option is selected the string displayed on the XBT G/XBT GT screen is: **HELLO!**.
- If **High byte first Equipment Configuration** (See *Equipment Configuration, p. 33*) option is selected the string displayed on the XBT G/BT GT screen is: **EHLL!O**.

IEC equivalences

The following table gives the equivalences between the Modbus syntax and the IEC61131 syntax.

Variable Type	Modbus address syntax			IEC61131 syntax		
	Format	Range	First element	Format	Range	First element
Internal coils and Output coils	00001+i	i=0 to 65535	00001 (1)	%Mi	i=0 to 65535	%M0
Holding register (word)	40001+i	i=0 to 65535	40001	%MWi	i=0 to 65535	%MW0
Holding register (word bit)	40001+i,j (2)	i=0 to 65535 j=0 to 15	40001,0	%MWi:Xj	i=0 to 65535 j=0 to 15	%MW0:X0
Holding register (double word)	40001+i	i=0 to 65534	40001	%MDi	i=0 to 65534	%MD0
Holding register (float)	40001+i	i=0 to 65534	40001	%MFi	i=0 to 65534	%MF0
Holding register (string)	40001+i	i=0 to k (3)	40001	%MWi	i=0 to k (3)	%MW0
legend:						
(1): Leading zeros "00001" must be preserved						
(2): j is a bit index with the following convention: 0 for the least significant bit and 15 for the most significant bit.						
(3): k is equal to 65535 - string length / 2 rounded to the upper value For instance with a 11 characters string we've got 65535 - 6 = 65529.						

Note: The two areas 10000 and 30000 are not accessible with the IEC syntax.

Consecutive Equipment Addresses

Overview

The following table lists the maximum number of consecutive addresses that can be read for each type of supported equipment. Refer to this table when using block transfers.

The Maximum Consecutive Address and Gap Span depend on the Preferred Frame Length you define in the Equipment Configuration dialog box (See *Equipment Configuration, p. 33*).

The Gap Span is calculated as the number of unused words between two variables addresses.

When two variable address on the same equipment are closer than the Gap Span value, they are read in the same request if the request length is less than the configured one. In other cases, they are read in two distinct requests.

- To speed up data communication, use consecutive variable addresses on the same panel screen.
- The following situations increase the number of times that the equipment is read, and reduces the data communication speed between the target machine and the Modbus equipment:
  - when the number of consecutive addresses exceeds the maximum
  - when an address is designated for division
  - when different equipment types are used.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Set the preferred frame length to a value at least equal to the largest expected variable length. If the Preferred Frame Length is less than the variable length, read or write errors may occur.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

Note: If the minimum value is selected for the Preferred Frame Length, to read double words you need to:

- link the two consecutive addresses of the double word (32 bits variable) to two XBT G/XBT GT 16 bit variable,
- create a double word (32 bit) variable in the XBT G/XBT GT,
- create a script for each 16 bit variables which updates the 32 bit variable with the contents of the two 16 bit variables every time the 16 bit variable changes.

Consecutive addresses

The following table lists the maximum number of consecutive addresses that can be read for each type of equipment when **Preferred Frame Length=Maximum Possible** (252 bytes).

Equipment	Max. consecutive addresses	Gap Span
Coils	2000 bits	127 bits
Discrete Inputs		
Input Registers	125 words	24 words
Holding Registers		

The following table lists the maximum number of consecutive addresses that can be read for each equipment when **Preferred Frame Length=user defined value** (from 6 to 252).

Equipment	Max. consecutive addresses	Gap Span
Coils	(Preferred Frame Length x 16) or 2000 Bits, whichever is less	127 bits
Discrete Inputs		
Input Registers	(Preferred Frame Length – 2) / 2	24 words
Holding Registers		

Note: When **Preferred Frame Length = Minimum Possible**, the max consecutive addresses is 1 for bits and words.

Environment Setup

Overview

The following table lists the communication settings, recommended by Schneider Electric, for the target machine and Modbus equipment.

For details, see Driver section (See *Driver Configuration, p. 31*) and Equipment section (See *Equipment Configuration, p. 33*).

RS-485 settings

Driver settings.

Target Machine Settings			**Equipment Settings**	
Driver Interface	Serial Interface	RS-485	Connection Format	RS-485
	Flow Control	None	--	
	Wrapping Speed	19200 bps	Baud Rate	19200 bps
	Retry Count	2	--	
	Parity Bit	Even	Parity Bit	Even
	Stop Bit	1 bit	Stop Bit	1 bit
	Data Length	8 bit	--	
	Rcv. Time Out	3 s	--	
	TX Wait Time	2 ms (Default value checked)	2 ms	
	Default value	Checkbox selected	--	
	--		Mode/Data Bits	RTU (8)

RS-232C settings Driver settings.

Target Machine			Equipment Settings	
Driver interface	Serial Interface	RS-232C	Connection Format	RS-232C
	Flow Control	DTR(ER)/CTS	--	
	Wrapping Speed	19200 bps	Baud Rate	19200 bps
	Retry Count	2	--	
	Parity Bit	Even	Parity Bit	Even
	Stop Bit	1 bit	Stop Bit	1 bit
	Data Length	8 bits	--	
	Rcv. Time-out	10 s	--	
	TX Wait Time	2 ms (Default value checked)	2 ms	
	Default value	Checkbox selected	--	
	--		Mode/Data Bits	RTU 8

Equipment Equipment settings.

Target Machine Settings		Equipment Settings	
Equipment No.	1	Station Address	1
Preferred Frame Length	**Minimum Possible** for equipment which does not have continuous registers (Altivar products for instance) and **Maximum Possible** for the others.	--	
IEC61131 Syntax	Selected by Default, use it for Premium PLCs and unchecked it for Quantum PLCs.	--	
Double Word word order	**Low word first** for Premium PLCs. **High word first** for Quantum PLCs.	--	
ASCII display byte order	**Low byte first** for Premium PLCs or to have the same behavior as XBTL1000. **High byte first** for Quantum PLCs or to have the same behavior as Vijeo Designer V4.1.	--	

I/O Manager Configuration

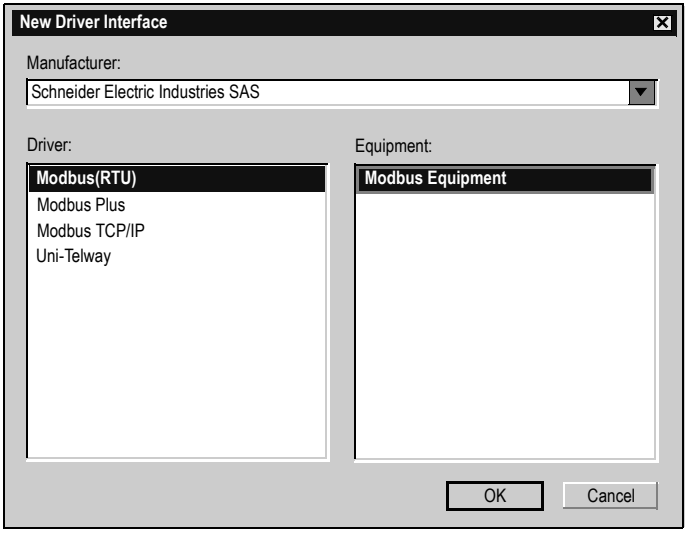
Overview

The driver and equipment, which enable communication between the target machine and the equipment, depends on the equipment type.

Note: For information on how to display the **New Driver Interface** dialog box, or for details about the I/O Manager, see the online help: Communications -> Setting Up Your Equipment -> Adding a Device Driver.

Screen example

Screen example of I/O Manager Configuration.



Driver Configuration

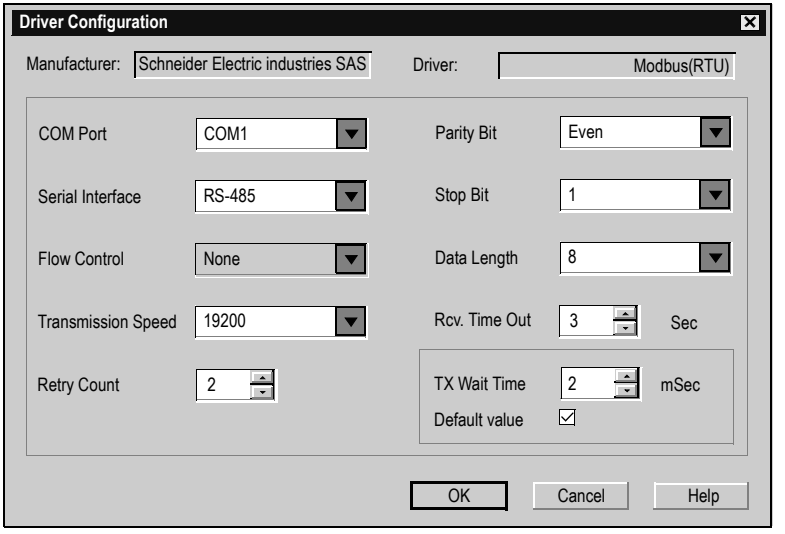
Overview

To configure the communication settings of the serial driver in the target machine, use the **Driver Configuration** dialog box. Make sure the settings match those of the Modbus equipment (See *Environment Setup, p. 28*).

Note: For information on how to display the **Driver Configuration** dialog box, see the online help: Communications -> Setting Up Your Equipment -> Configuring Communications Settings.

Screen example

Screen example of Driver Configuration.



Description

Screen description.

Area	Description
Manufacturer	Displays the name of the Equipment manufacturer.
Interface	Displays the type of serial connection used to connect the target machine to the Modbus equipment.
COM Port	Defines which COM port to use on the target machine, for connecting to the equipment.
Serial Interface	Defines the serial connection (See *Cable Diagrams, p. 14*) for the selected COM Port: RS-232C or RS-485 for COM1, or RS-232C (fixed) for COM2.
Flow Control	Set to **None**, the driver handles flow control internally.
Transmission Speed	Sets the communication speed in bits per second. This setting must match the equipment baud rate.
Retry Count	Defines the number of times the driver tries to send or receive data when there is an error.
Parity Bit	Sets a parity bit [Even or Odd] for use in detecting communication errors, or [None].
Stop Bit	Defines the stop bit: 1 or 2 bits.
Data Length	Defines the length of each unit of data: 7 bit or 8 bit.
Rcv. Timeout	Defines the length of time the target machine waits for a response before it generates a timeout error or sends another communication request.
TX Wait Time	Defines the number of milliseconds that the target machine waits, after receiving a communication packet, before sending a new request. Minimum TX Wait Time is at least 3.5 character time. **Note**: this parameter is automatically changed by the software to be consistent with the tranmission speed. However you could change it to increase its value manually.
Default value	When selected, TX Wait Time is automatically updated to the transmission duration of 3.5 characters. When Cleared, you will need to specify the TX Wait Time.

Equipment Configuration

Overview

To set up details about the communication process between the target machine and the equipment, use the **Equipment Configuration** dialog box.

For an overview of the driver and protocol settings, see the setting section (See *Environment Setup, p. 28*).

⚠ WARNING

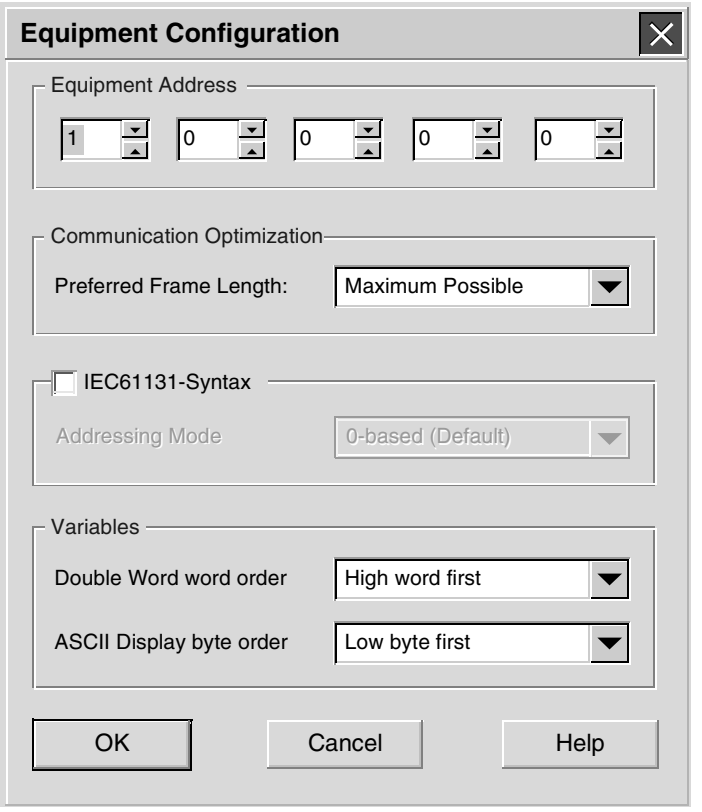
UNINTENDED EQUIPMENT OPERATION

Do not use Modbus addresses 65, 126, or 127 if a gateway's Modbus slaves will include a Schneider Electric Speed Variation device such as an Altistart soft-starter or an Altivar motor drive. The Altistart and Altivar devices reserve these addresses for other communications.

Failure to follow this instruction can result in death, serious injury, or equipment damage.

Note: For information on how to display the **Equipment Configuration** dialog box, see the online help: Communications -> Setting Up Your Equipment -> Configuring Communications Settings.

Screen example Screen example of Equipment Configuration.



Description

Screen description.

<table>
<tr><th>Area</th><th>Description</th></tr>
<tr><td>Equipment Address.</td><td>Enter a value of (1-247) to identify the equipment that the target machine communicates with. This value must match the Station Address set up on the equipment.</td></tr>
<tr><td>Preferred Frame Length:</td><td>To optimize the communication you could choose the Frame length:
• Maximum Possible: the maximum frame length allowed by the server is used (optimization is validated).
• Minimum Possible: the request optimization is not used (each variable uses a dedicated request).
• 6 to 252 bytes: type a value to determine the Frame length. This option is used when some hardware need a specific length.</td></tr>
<tr><td>Addressing Mode</td><td>To define the Addressing Mode:
• When using IEC61131 Syntax, for most equipment, including Premium and Momentum PLCs, select 0-based addressing, which allows register addresses starting with 0 (e.g. 0 to 65535.)
• When using Quantum equipment, select 1-based addressing, which allows register addresses starting with 1 (e.g. 1 to 65536.)</td></tr>
<tr><td>IEC61131 Syntax</td><td>if checked, the IEC variable address syntax is used (See Supported Equipment Variable Addresses, p. 21) (%M,%MW,%MD,...).</td></tr>
<tr><td>Double Word word order</td><td>To define the transmit word order for 32 bit variables.
(See Variable mapping, p. 24)</td></tr>
<tr><td>ASCII Display byte order</td><td>• Low byte first : to have the same behavior as XBT L1000 software.
• High byte first : to have the same behavior as Vijeo Designer V4.1 software.
Inside PLCs a STRING is usually an array of words for which every word contains two characters (one character per byte). For example the HELLO! string representation is the following:
<table>
<tr><th>Word order</th><th>Most significant byte</th><th>Least significant byte</th></tr>
<tr><td>First word</td><td>E</td><td>H</td></tr>
<tr><td>Second word</td><td>L</td><td>L</td></tr>
<tr><td>Third word</td><td>!</td><td>O</td></tr>
</table>
• If Low byte first option is selected the string displayed on the XBT G/BT GT screen is: HELLO!.
• If High byte first option is selected the string displayed on the XBT G/BT GT screen is: EHLL!O.</td></tr>
</table>

Equipment Variable Address Configuration

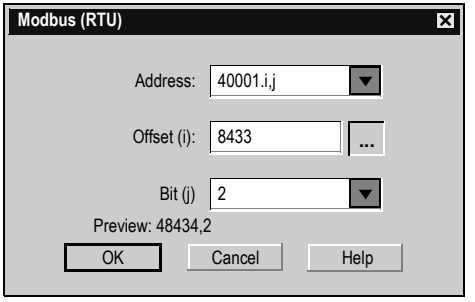
Overview

To define an equipment address for a variable (See *Supported Equipment Variable Addresses, p. 21*) in the Variable List, use the Equipment Address Keypad from the variable properties.

Note: To display the **Equipment Address Keypad**, click on the [...] button.

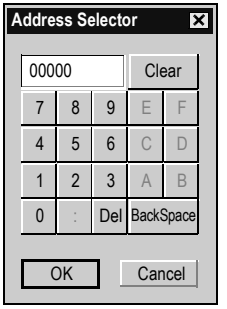
Screen example 1

Screen example of Equipment Address Configuration without IEC box checked.



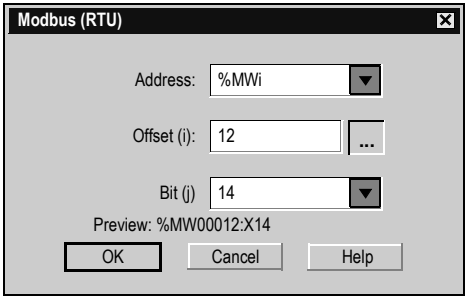
Description

Screen description.

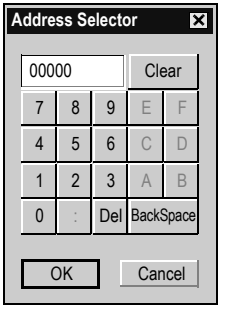
Area	Description
Address	Choose the start address.
Offset (i)	Define the offset of the equipment's discrete and word equipment types. Type the offset or use the [Address Selector] keypad to enter the offset: 
Bit (j)	List the bit position (0-15) of the equipment's discrete and word equipment types. **Example**: let's look at a register 40100 and assume the value of 5 is loaded: 40100 = 5 In Binary, 40100 = 0000 0000 0000 0101 (16 bits) (assume Least Significant Bit, LSB is far right and this is j=0.) So, 40001 + i, j where i=99 and: j=0 the bit is 1 j=1 the bit is 0 j=2 the bit is 1 j=3 the bit is 0 j=4 the bit is 0 and so on.
Preview	Typing the offset or the Bit allows you to preview the address immediately. Using the Address selector updates the Preview after you click OK.

Note: Be careful when you send STRING as table of word on Modbus (See *Variable mapping, p. 24*) because each word LSB and MSB are inverted between Quantum and Premium PLC.

Screen example 2 Screen example of Equipment Address Configuration whith IEC box checked.



Description Screen description.

Area	Description
Address	Choose the address type (%M, %MW, %MD...).
Offset (i)	Define the offset of the equipment's discrete and word equipment types. Type the offset or use the [Address Selector] keypad to enter the offset: 
Bit (j)	List the bit position (0-15) of the equipment's discrete and word equipment types. **Example**: let's look at a %MW10 the value of 5 is loaded: %MW10 = 5 In Binary, %MW10 = 0000 0000 0000 0101 (16 bits) (assume Least Significant Bit, LSB is far right and this is j=0.) So, %MW10:Xj : j=0 the bit is 1 j=1 the bit is 0 j=2 the bit is 1 j=3 the bit is 0 j=4 the bit is 0 and so on.
Preview	Typing the offset or the Bit allows you to preview the address immediately. Using the Address selector updates the Preview after you click OK.

Note: Be careful when you send STRING as table of word on Modbus (See *Variable mapping, p. 24*) because each word LSB and MSB are inverted between Quantum and Premium PLC.

Modbus RTU Communication: General Principles

2

At a Glance

Subject of this Chapter

This chapter presents the Modbus RTU communication protocol used by the XBT G/ XBT GT terminals and configurable using Vijeo Designer.

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
General	42
Operating Principle	44
Example of a Serial Modbus RTU Communication Bus	46

General

At a Glance

Modbus RTU is a field bus used to communicate between devices of the same type according to a protocol defined by Modicon.

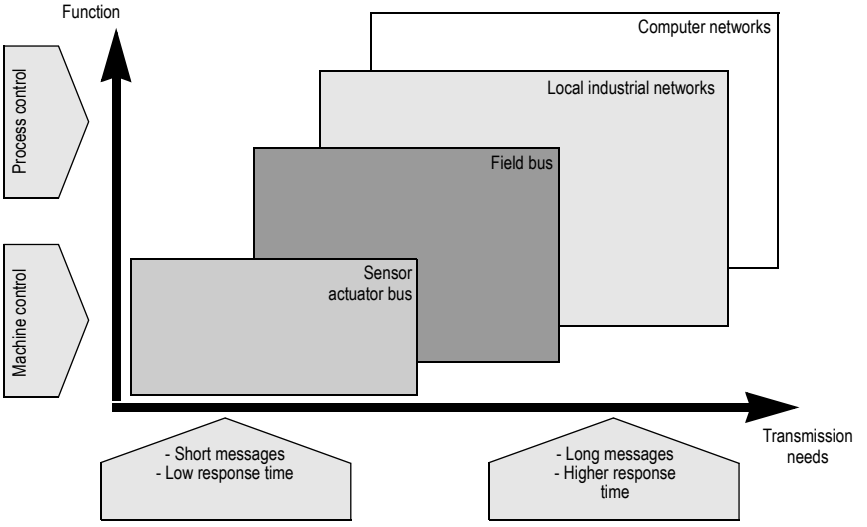
Numerous proprietary or third-party devices can be used on this bus, which has become one of the industry standards.

The communication protocol terminology defines the software (driver) installed in the devices that are connected to the Modbus RTU bus.

This section gives a brief description of the principles of the communication bus.

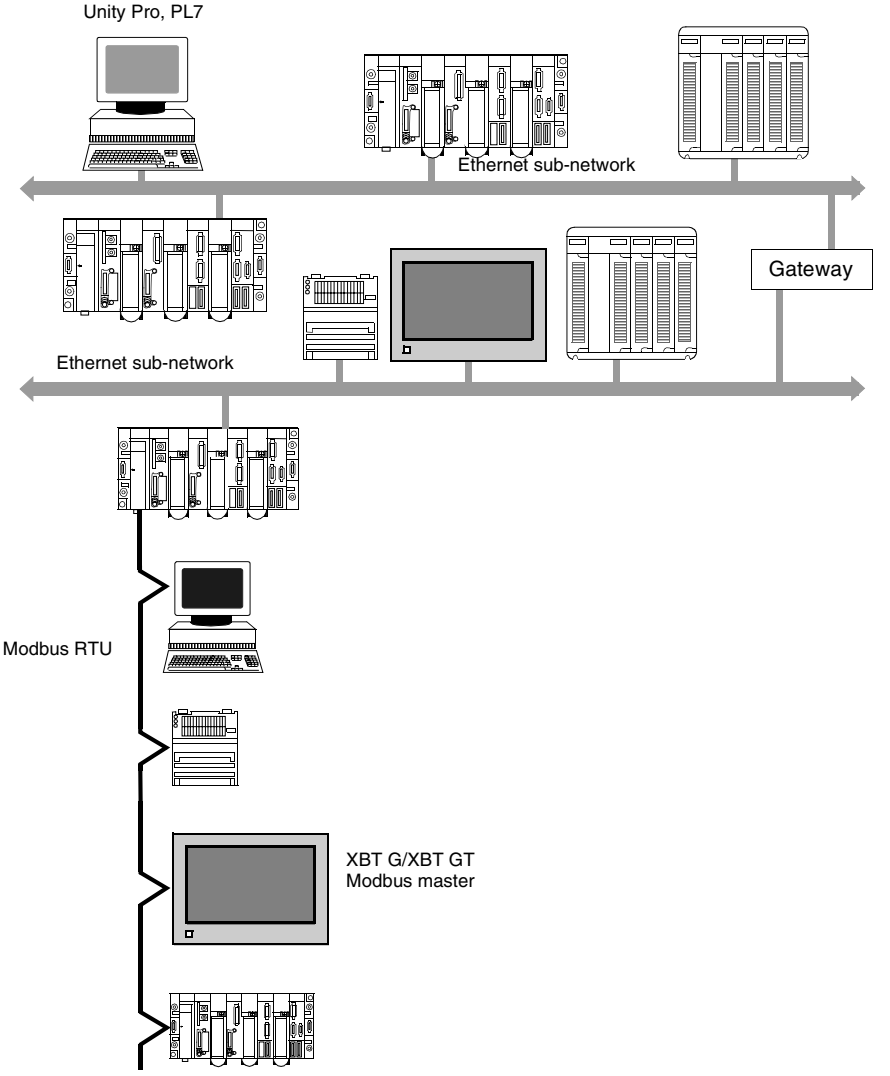
Illustration

The following illustration shows the position of the field buses in an industrial communication environment.



Architecture Example

The following illustration shows a communication architecture, featuring a serial Modbus RTU bus.



Operating Principle

At a Glance

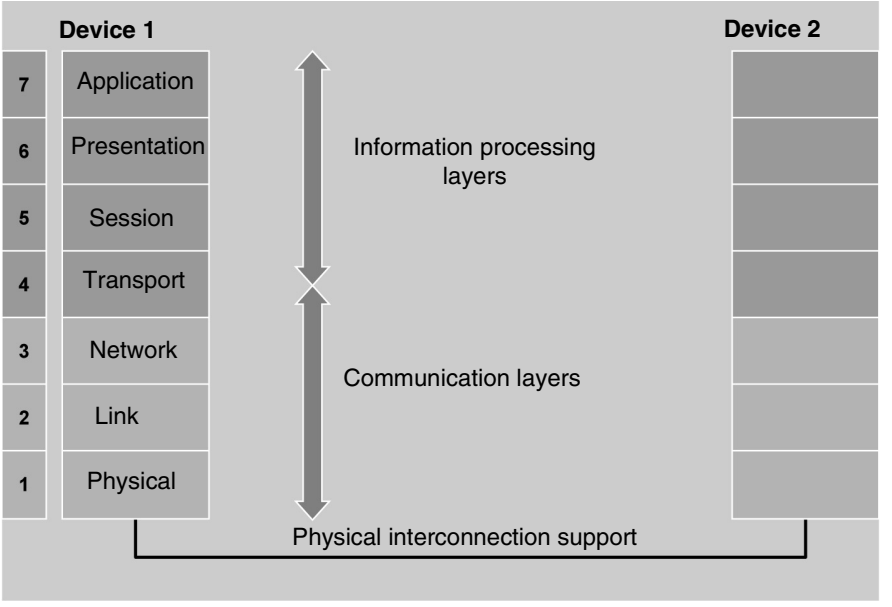
Communication between same-type devices can only take place by defining interconnection standards that define the behavior of each device in relation to the others. These standards were developed by ISO (the International Standard Organization), which defined a standardized Network Architecture more commonly known as the OSI (Open System Interconnection) model.

This model is made up of seven ranked layers that each perform a specific part of the functions necessary for interconnecting systems.

The layers communicate with equivalent layers from other devices, via standardized protocols. Within a single device, layers communicate with their immediate neighbors via hardware or software interfaces.

Illustration

The figure below describes the layers of the OSI model.



Note: The Modbus RTU bus matches this model in terms of layers, without possessing all of them. Only the Application (Modbus), Network, Link and Physical (Modbus RTU) layers are necessary for this field bus.

Application Layer

The application layer of the RTU Modbus serial field bus is the one visible to the programs of the interconnected devices. This is used to formulate the requests (reading/writing words and bits, etc.) that will be sent to the remote device.

The Application layer used by the Modbus RTU bus is the Modbus application protocol.

Example: an XBT G/XBT GT connected to a Modbus RTU bus as master will send Modbus requests in order to update the graphic objects displayed on these pages.

Note: For further details on the Modbus application protocol (request codes, class details, etc.), go to http://www.modbus.org.

Link Layer

The link layer of the serial Modbus RTU bus uses the Master/Slave communication principle. The principle of a link layer is to define a low-level communication method for the communication medium (physical layer). For the serial Modbus RTU bus, the Master/Slave method comprises polling slaves (interrogating each slave on the bus) via the master to find out if they have a message to send.

When a slave has a message to send, it answers the master, which then gives it authorization to send its message.

For each serial Modbus RTU bus, there must be a single master that controls the bus slaves.

Note: One reason for Master/Slave management is that at any time it is possible to calculate transfer time for requests and the answers from each device. This therefore enables us to size the buses precisely, in order that there be no saturation or information loss.

Note: XBT G/XBT GT is always the bus master.

Note: For further details (datagrams, frame sizes, etc.) go to http://www.modbus.org.

Physical Layer

The physical layer of the OSI model characterizes the topology of the communication bus or network, as well as the medium (cable, wire, fiber optic, etc.) that will transport the information and its electrical coding.

Within the framework of a serial Modbus RTU bus, topology may be daisy-chained, derived or a mix of both. The medium is made up of shielded twisted pairs, and the signal is a base band signal with a default speed of 9600 bits per second, even parity, 8 data bits and 1 stop bit.

Note: In order for all devices to be able to communicate among themselves on the same bus, the speed, parity and data bit number characteristics must be identical.

For further details, refer to the documentation of the devices connected to the bus. Within the framework of XBT G/XBT GT's, this information is provided in the section on configuring the Modbus RTU driver.

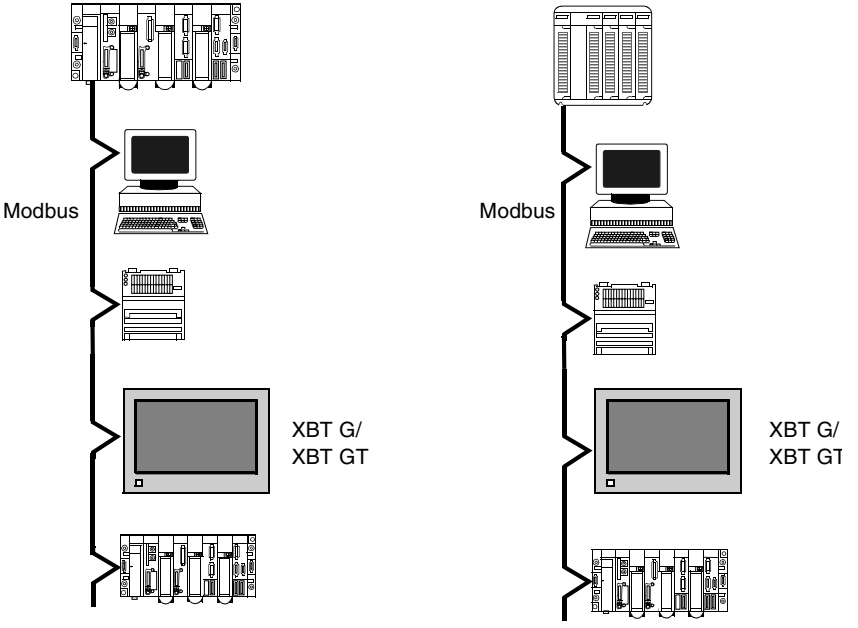
Example of a Serial Modbus RTU Communication Bus

At a Glance

Schneider devices are used to associate serial Modbus RTU communication buses with stand-alone stations, enabling them to communicate with XTB G/XBT GT operator dialog terminals.

Examples of Buses

The following figures show two examples of serial Modbus RTU buses, that can be used with stand-alone Premium or Quantum stations:



Note: XBT G/XBT GT is always the bus master.

Appendix

3

Modbus function codes and exception error codes

Modbus function codes

Table of Modbus function codes recognized by the XBT G/XBT GT.

Classes	Function name	Function code (hex)
Basic	Read Holding registers	03
Base	Write Multiple registers	10
Regular	Read Coils	01
Regular	Read Discrete Inputs	02
Regular	Write Multiple Coils	0F
Regular	Diagnostic	08
Supplementary services	Read Input registers	04
Supplementary services	Write Single Coil	05
Supplementary services	Write Single register	06
Supplementary services	Read Device Identification (only for Modbus TC/IP with XBT G/XBT GT server)	2B

Note: By default the XBT G/XBT GT uses the function code **10** (FC 10) to write multiple registers. However, some devices do not know this function code. When a device doesn't know **FC 10**, the XBT G/XBT GT will automatically use (without any error code) **FC 06**. In the same way, the XBT G/XBT GT will use **FC 05** instead of **FC 0F**. In addition, **FC 06** and **FC 05** will be used if Preferred Frame Length is set to Minimum possible.

Modbus exception responses

When a client device sends a request to a slave device it expects a normal response. One of four possible events can occur from the master's query:

- If the slave receives the request without a communication error, and can handle the query normally, it returns a normal response.
- If the slave does not receive the request due to a communication error, no response is returned. The client program will eventually process a time-out condition for the request.
- If the slave receives the request, but detects a communication error (parity, LRC, CRC,...), no response is returned. The client program will eventually process a time-out condition for the request.
- If the slave receives the request without a communication error, but cannot handle it (for example, if the request is to read a non–existent output or register), the server will return an exception response informing the client of the nature of the error.

Table of Modbus Exception responses.

Code	Name	Meaning
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, a request with offset 96 and length 4 would succeed, a request with offset 96 and length 5 will generate exception 02.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register.
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.
05	ACKNOWLEDGE	Specialized use in conjunction with programming commands. The server (or slave) has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a time-out error from occurring in the client (or master). The client (or master) can next issue a Poll Program Complete message to determine if processing is completed.
06	SLAVE DEVICE BUSY	Specialized use in conjunction with programming commands. The server (or slave) is engaged in processing a long–duration program command. The client (or master) should retransmit the message later when the server (or slave) is free.

Code	Name	Meaning
08	MEMORY PARITY ERROR	Specialized use in conjunction with function codes 20 and 21 and reference type 6, to indicate that the extended file area failed to pass a consistency check. The server (or slave) attempted to read record file, but detected a parity error in the memory. The client (or master) can retry the request, but service may be required on the server (or slave) device.
0A	GATEWAY PATH UNAVAILABLE	Specialized use in conjunction with gateways, indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing the request. Usually means that the gateway is misconfigured or overloaded.
0B	GATEWAY TARGET DEVICE FAILED TO RESPOND	Specialized use in conjunction with gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network.

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