Concept
X(X)MIT-IEC / RTXMIT Transmit (Receive) Function Block

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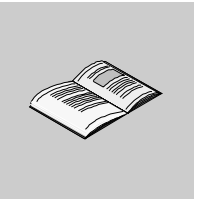
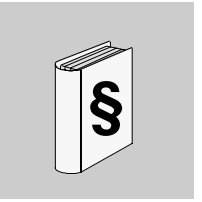
Table of Contents



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 or serious injury.

⚠ WARNING

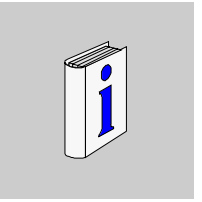
WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

⚠ CAUTION

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

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

About the Book



At a Glance

Document Scope

This manual presents all information neccessary to configure the XMIT, XXMIT and the RTXMIT function blocks on all PLC platforms supporting the IEC languages.

Validity Note

The information contained in this book is valid for Concept version 2.6 Service release 1 and later.

Related Documents

Title of Documentation	Reference Number
Concept Installation	840 USE 502 00
Concept User Manual	840 USE 503 00
Concept IEC Block Libraries	840 USE 504 00

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User Comments

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Introduction to XXMIT and RTXMIT

1

At a Glance

Overview

This chapter gives a general overview on the transmit function block XXMIT and the transmit/receive function block RTXMIT.

What's in this Chapter?

This chapter contains the following topics:

XXMIT Functionality

Function Overview

The XXMIT (Transmit) function block enable the use of the PLCs serial ports for communication under the control of the application program.

The following communication types are supported:

- Modbus as Master
- Simple ASCII Input/Output
- ASCII Input with one or two termination characters
- Modem Communication

Function Description

The Transmit blocks send Modbus messages from a "master" PLC to multiple slave PLCs or sends ASCII character strings from the PLC's Modbus slave port #1 (on Momentum PLCs also port #2 is supported) to ASCII printers and terminals. XXMIT sends these messages over telephone dialup modems, radio modems, or simply direct connections. The Transmit blocks perform general ASCII input functions in the communication mode including simple ASCII and terminated ASCII. You may import and export ASCII or binary data into your PLC. The block has builtin diagnostics that checks to make sure no other Transmit blocks are active in the PLC on the same port. Within the Transmit blocks, control inputs allows you to control the communications link between the PLC and DCE (Data Communication Equipment) devices attached to Modbus port #1 or port #2 of the PLC. The Transmit blocks do NOT activate the port LED when transmitting data.

RTXMIT Functionality

Function Overview

The RTXMIT (Receive/Transmit) function block enable the use of the PLCs serial ports for full duplex communication under the control of the application program.

The following communication types are supported:

- Simple ASCII Input/Output
- ASCII Input with one or two termination characters

Function Description

The RTXMIT Transmit block sends ASCII character strings from the PLC's Modbus slave port#1 (on Momentum PLCs also port#2 is supported) to ASCII printers, terminals or any other serial device. The Transmit blocks perform general ASCII input functions in the communication mode including simple ASCII and terminated ASCII. You may import and export ASCII or binary data into your PLC. The RTXMIT block can send and receive characters at the same time (full duplex). The block has builtin diagnostics that checks to make sure no other Transmit blocks are active in the PLC on the same port. Within the Transmit blocks, control inputs allows you to control the communications link between the PLC and DCE (Data Communication Equipment) devices attached to Modbus port #1 or port#2 of the PLC. The Transmit blocks do NOT activate the port LED when transmitting data.

XMIT: Transmit (Momentum)

2

At a Glance

Introduction

This chapter describes the XMIT function block.

What's in this Chapter?

This chapter contains the following topics:

Brief Description

Function Description

The XMIT (Transmit) function block sends Modbus messages from a "master" PLC to multiple slave PLCs or sends ASCII character strings from the PLC's Modbus slave port #1 or port #2 to ASCII printers and terminals. XMIT sends these messages over telephone dialup modems, radio modems, or simply direct connection. XMIT performs general ASCII input functions in the communication mode including simple ASCII and terminated ASCII. You may import and export ASCII or binary data into your PLC and convert it into various binary data or ASCII to send to DCE devices based upon the needs of your application. The block has builtin diagnostics that checks to make sure no other XMIT blocks are active in the PLC on the same port. Within the XMIT block a control table allows you to control the communications link between the PLC and DCE (Data Communication Equipment) devices attached to Modbus port #1 or port #2 of the PLC. The XMIT block does NOT activate the port LED when it is transmitting data.Remember, the Modbus protocol is a "master/slave" protocol. Modbus is designed to have only one master polling multiple slaves. Therefore, when using the XMIT block in a network with multiple masters, contention resolution and collision avoidance is your responsibility and may easily be addressed through ladder logic programming.

EN and ENO can be configured as additional parameters

Using Modbus

Remember, the Modbus protocol is a "master/slave" protocol. Modbus is designed to have only one master polling multiple slaves. Therefore, when using the XMIT block in a network with multiple masters, contention resolution and collision avoidance is your responsibility and may easily be addressed through user logic programming.

Restrictions

This function block controls Modbus port #1 and #2 of the Momentum CPUs. It can be used with the stripped exec only. The XMIT function block works just as its LL984 counterpart, but without ASCII string conversion, copy and compare functions and without the Port Status functions.

Software and Hardware Required

When using the Momentum PLCs the XMIT function block it is a builtin.

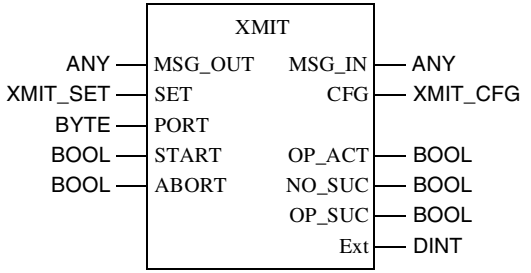
The following hardware is not supported by the XXMIT function block:

- Soft PLC
- Atrium 386 and Atrium-S908 PLCs
- IEC Simulator

Representation

Symbol

Representation of the block



Parameter Description

Description of the block parameter

Parameters	Data type	Meaning
SET	XMIT_SET	Data structure for the XMIT configuration
MSG_OUT	ANY	Message to be sent (must be in 4x range)
PORT	BYTE	Selection of communications interface
START	BOOL	1: Starts XMIT operation
ABORT	BOOL	1: Aborts current XMIT operation
MSG_IN	ANY	Incoming message (must be in 4x range)
CFG	XMIT_CFG	Data structure with all components of the XMIT configuration, including the automatically set and not used variables. Only for display and must be in 4x range.
OP_ACT	BOOL	1: XMIT operation in progress
NO_SUC	BOOL	1: There is an error or the current XMIT operation is aborted.
OP_SUC	BOOL	1: XMIT operation successfully completed
Ext	DINT	not presently in use

XMIT_SET Data Structure

Description of data structure

Element	Data type	Meaning
BaudRate	WORD	This component corresponds to the 4x+3 register (data rate) of the LL984 XMIT instruction.
DataBits	BYTE	This component corresponds to the 4x+4 register (data bits) of the LL984 XMIT instruction.
Parity	BYTE	This component corresponds to the 4x+5 register (parity) of the LL984 XMIT instruction.
StopBits	BYTE	This component corresponds to the 4x+6 register (stop bits) of the LL984 XMIT instruction.
Command Word	WORD	This component corresponds to the 4x+8 register (command word) of the LL984 XMIT instruction.
MessageLen	WORD	This component corresponds to the 4x+10 register (message length) of the LL984 XMIT instruction. (In case of a terminated ASCII receipt, this component will be set automatically.)
RespTimeOut	WORD	This component corresponds to the 4x+11 register (response time-out (ms)) of the LL984 XMIT instruction.
RetryLimit	WORD	This component corresponds to the 4x+12 register (retry limit) of the LL984 XMIT instruction.
XmStartDelay	WORD	This component corresponds to the 4x+13 register (start of transmission delay (ms)) of the LL984 XMIT instruction.
XmEndDelay	WORD	This component corresponds to the 4x+14 register (end of transmission delay (ms)) of the LL984 XMIT instruction.

XMIT_CFG Data Structure

Description of data structure

Element	Data type	Meaning
FaultStatus	WORD	This component corresponds to the 4x+1 register (fault status) of the LL984 XMIT instruction.
UserAvail_1	WORD	This component corresponds to the 4x+2 register (available to user) of the LL984 XMIT instruction.
BaudRate	WORD	This component corresponds to the 4x+3 register (data rate) of the LL984 XMIT instruction.
DataBits	WORD	This component corresponds to the 4x+4 register (data bits) of the LL984 XMIT instruction.
Parity	WORD	This component corresponds to the 4x+5 register (parity) of the LL984 XMIT instruction.
StopBits	WORD	This component corresponds to the 4x+6 register (stop bits) of the LL984 XMIT instruction.
UserAvail_2	WORD	This component corresponds to the 4x+7 register (available to user) of the LL984 XMIT instruction.
Command Word	WORD	This component corresponds to the 4x+8 register (command word) of the LL984 XMIT instruction.
MessagePtr	WORD	This component corresponds to the 4x+9 register (message pointer) of the LL984 XMIT instruction.
MessageLen	WORD	This component corresponds to the 4x+10 register (message length) of the LL984 XMIT instruction.
RespTimeOut	WORD	This component corresponds to the 4x+11 register (response time-out (ms)) of the LL984 XMIT instruction.
RetryLimit	WORD	This component corresponds to the 4x+12 register (retry limit) of the LL984 XMIT instruction.
XmStartDelay	WORD	This component corresponds to the 4x+13 register (start of transmission delay (ms)) of the LL984 XMIT instruction.
XmEndDelay	WORD	This component corresponds to the 4x+14 register (end of transmission delay (ms)) of the LL984 XMIT instruction.
CurrentRetry	WORD	This component corresponds to the 4x+15 register (current retry) of the LL984 XMIT instruction.

Parameter Description

MSG_OUT

MSG_OUT contains the message data to be transferred, for example, ASCII characters for an ASCII transfer, definition of termination characters for terminated ASCII input or Modbus templates for Modbus master messages.

The data type that must be assigned to the parameter has to be a data type WORD array. This array has to be assigned to a 4x register range. The field length must equal the length of the MSG_IN field. If the field is assigned to the range for Unlocated variables, a runtime error message will be generated.

SET

SET contains the configuration of the XMIT function block in form of the XMIT_SET data structure. This parameter may be assigned to an Unlocated variable.The data structure components have the same function as the components of the LL984 XMIT configuration. There is only one difference, the variables are set automatically by the system and the unused variables are not shown in this data structure. This means, a complete configuration requires that all components in this data structure have to be defined.

PORT

PORT specifies the communications interface. The only authorized values are 1 and 2.

START

A 1-signal at START initiates the XMIT operation. The 1-signal must be applied until the operation has finished or until an error has occurred.

ABORT

A 1-signal terminates the current XMIT operation and writes the abort code "121" to the "FaultStatus" component of the XMIT_CFG data structure at the CFG output.

MSG_IN

MSG_IN contains the incoming message data, for example, terminated ASCII input or responses of a Modbus master command which was previously sent by the XMIT function block.The data type that must be assigned to the parameter has to be a data type WORD array. This array has to be assigned to a 4x register range. The field length must equal the length of the MSG_OUT field. If the field is assigned to the range for Unlocated variables, a runtime error message will be generated.

CFG

CFG contains an XMIT function block copy of the configuration defined on SET which has the form of data structure XMIT_CFG, it includes the automatically set and not used variables.The data structure components have the same function as the components of the LL984 XMIT configuration.This data structure has to be assigned to a 4x register range. If the data structure is assigned to the range for Unlocated variables, a runtime error message will be generated. CFG is used to verify the actually applied configuration.

OP_ACT	A 1-signal indicates that an XMIT operation is in progress.
NO_SUC	A 1-signal indicates that an error has occurred or that the current XMIT operation is terminated.
OP_SUC	A 1-signal indicates that the XMIT operation has been completed successfully.
EXT	Presently not use. Do not connect

Description of Data Structure XMIT_SET

XMIT_SET

This data structure contains the particular configuration for the XMIT operation. This variable may be stored in the unlocated memory. The elements of this structure have the same meaning as the corresponding elements of the XMIT_CFG (see *Description of Data Structure XMIT_CFG, p. 20*) structure. XMIT_SET is used to configure the XMIT block. The values of this data structure are transfered to XMIT_CFG.

Note: XMIT_SET does not contain the MessagePtr element. This is automatically set to the adress of the MSG_IN array and placed into XMIT_CFG.

Description of Data Structure XMIT_CFG

At a Glance

This data structure contains the actual configuration data the XMIT block uses. Do not write directly to this array, as the content is automatically generated or copied from XMIT_SET. The following is a detailed description of each of the (16) XMIT communication control table registers.

XMIT_CFG.Revision Read Only

Displays the current revision number of XMIT block. This number is automatically loaded by the function block and over writes any other number entered into this register.

XMIT_CFG.Fault Status Read Only

This field displays a fault code generated by the XMIT block. A complete list is shown in the table below.

Fault Code	Fault Description
1	Modbus exception - Illegal function
2	Modbus exception - Illegal data address
3	Modbus exception - Illegal data value
4	Modbus exception - Slave device failure
5	Modbus exception - Acknowledge
6	Modbus exception - Slave device busy
7	Modbus exception -Negative acknowledge
8	Modbus exception -Memory parity error
9 ... 99	Reserved
100	Slave PLC data area cannot equal zero
101	Master PLC data area cannot equal zero
102	Coil (0x) not configured
103	Holding register (4x) not configured
104	Data length cannot equal zero
105	Pointer to message table cannot equal zero
106	Pointer to message table is outside the range of configured holding registers (4x)
107	Transmit message time-out (This error is generated when the UART cannot complete a transmission in 10 seconds or less. This error bypasses the retry counter and will activate the error output on the first error).
108	Undefined error
109	Modem returned ERROR
110	Modem returned NO CARRIER

Fault Code	Fault Description
111	Modem returned NO DIALTONE
112	Modem returned BUSY
113	Invalid LRC checksum from the slave PLC
114	Invalid CRC checksum from the slave PLC
115	Invalid Modbus function code
116	Modbus response message time-out
117	Modem reply time-out
118	XMIT could not gain access to PLC communications port #1 or port #2
119	XMIT could not enable PLC port receiver
120	XMIT could not set PLC UART
121	User issued an abort command
122	not used
123	not used
124	Undefined internal state
125	Broadcast mode not allowed with this Modbus function code
126	DCE did not assert CTS
127	Illegal configuration (data rate, data bits, parity, or stop bits)
128	Unexpected response received from Modbus slave
129	Illegal command word setting
130	Command word changed while active
131	Invalid character count
132	Invalid register block
133	ASCII input FIFO overflow error
134	Invalid number of start characters or termination characters

XMIT_CFG.User Avail_1

The XMIT block does not use this register. However, it may be used in the user logic as a pointer.

XMIT_CFG.Data Bits

XMIT supports the following data bits: 7 and 8. To configure a data bit size, enter its decimal number into this element. Modbus messages may be sent in ASCII mode or RTU mode. ASCII mode requires 7 data bits, while RTU mode requires 8 data bits. When sending ASCII character message you may use either 7 or 8 data bits. When an invalid data bit is entered, the block displays an illegal configuration error (error code 127) in the XMIT_CFG.FaultStatus element. For more details on Modbus message formats refer to Modicon Modbus Protocol Reference Guide (PI MBUS 300).

XMIT_CFG.Parity

XMIT supports the following parity: none, odd and even. Enter a decimal of either: 0 = no parity, 1 = odd parity, or 2 = even parity. When an invalid parity is entered, the block displays an illegal configuration error (error code 127) in the XMIT_CFG.FaultStatus element.

XMIT_CFG.Stop Bits

XMIT supports one or two stop bits. Enter a decimal of either: 1 = one stop bit, or 2 = two stop bits. When an invalid stop bit is entered, the block displays an illegal configuration error (error code 127) in the XMIT_CFG.FaultStatus element.

XMIT_CFG.User Avail_2

The XMIT block does not use this element. However, it may be used in the user logic as a pointer.

XMIT_CFG. CommandWord

The XMIT interprets each bit of the command word as a function to perform. If bit 7 and 8 are on simultaneously or if any two or more of bits 13, 14, 15 or 16 are on simultaneously or if bit 7 is not on when bits 13, 14, 15, or 16 are on error 129 will be generated. Other restrictions apply. For more details refer to *Command Word Bits, p. 30*. The individual bit definitions are shown in the table below.

Bit	Definition
Bit 1 (msb)	Reserved
Bit 2 Enable RTS/CTS modem control	Set to 1 when a DCE connected to the PLC requires hardware handshaking using RTS/CTS control. This bit may be used in conjunction with values contained in XMIT_CFG.XmStartDelay and XMIT_CFG.XmEndDelay. Start of transmission delay keeps RTS asserted for (X mS) before XMIT sends message out of PLC port. Likewise, end of transmission delay keeps RTS asserted for (X mS) after XMIT has finished sending a message out of the PLC port. Once the end of transmission delay expires XMIT de-assert RTS.
Bit 3 Enable RS485 mode	Set to 1 when the selected port should operate in RS485 mode. Otherwise it defaults to 0, which is RS232 mode.

Bit	Definition
Bit 4	Reserved
Bit 5 Terminated ASCII input	Set to 1 to remove and discard all characters from FIFO until the starting string is matched, then these starting characters and subsequent characters are written into the MSG_IN array until the terminator sequence is matched. The terminator string is also written into the MSG_IN array. Refer to chapter "Terminated ASCII Input Function (see *Terminated ASCII Input Function, p. 27*)" for more details.
Bit 6 Simple ASCII input	Set to 1 to remove the ASCII characters from FIFO for writing into the MSG_IN array. The Message pointer (XMIT_CFG.MessagePtr) is automatically set to the register address specified for the MSG_IN array. Refer to chapter "Simple ASCII Input Function (see *Simple ASCII Input Function, p. 29*)" for more details.
Bit 7 Enable ASCII string messaging	Set to 1 when you want to send ASCII messages out of the PLC. XMIT sends ASCII strings up to 1024 characters in length. You program the ASCII message into the MSG_OUT array. Two characters allowed per register. Only use Bit 7 OR Bit 8, do not try to use both. Refer to chapter "ASCII String Messaging (see *ASCII String Messaging, p. 29*) " for more details.
Bit 8 Enable Modbus messaging	Set to 1 when you want to send Modbus messages out of the PLC. Modbus messages may be in either RTU or ASCII formats. When data bits=8, XMIT uses Modbus RTU format. When data bits=7, XMIT uses Modbus ASCII format. Only use Bit 7 OR Bit 8, do not try to use both.
Bit 9 Enable ASCII receive FIFO	Set to 1 to allow the XMIT block to take control over the selected port (1 or 2) from the PLC. The block begins to receive ASCII characters into an empty 512 byte circular FIFO. Refer to chapter "ASCII Receive FIFO (see *ASCII Receive FIFO, p. 37*)" for more details.

Bit	Definition
Bit 10 Enable back space	Set to 1 to allow special handling of ASCII back space character (BS, 8Hex). When using either Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5) each back space character is removed from FIFO and may or may NOT be stored into the MSG_IN array. Refer to chapter "Enable Back space (see *Enable Back space, p. 37*)" for more details.
Bit 11 Enable RTS/CTS flow control	Set to 1 to allow full duplex hardware flow control using the RTS and CTS handshaking signals for ASCII massaging. The RTS/CTS operates in both the input and output modes. Refer to chapter "Enable RTS/CTS Flow Control (see *Enable RTS/CTS Flow Control, p. 38*)" for more details.
Bit 12 Enable Xon/Xoff flow control	Set to 1 to allow full duplex software flow control using the ASCII Xon character (DC1, 11 Hex) and the ASCII Xoff character (DC3, 13 Hex). The Xon/Xoff operates in both the input and output modes. Refer to chapter "Enable Xon/Xoff Flow Control (see *Enable Xon/Xoff Flow Control, p. 39*)" for more details.
Bit 13 Pulse dial modem	Set to 1 when using a Hayes compatible dial-up modem and you wish to pulse dial a telephone number. You program the phone number into the MSG_IN array. The length of the message must be in XMIT_SET.MessageLen. Pulse dialed numbers are sent to the modem automatically preceded by ATDP and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.
Bit 14 hangup modem	Set to 1 when using a Hayes compatible dial-up modem and you want to hangup the modem. You must use ladder logic to turn this bit ON. Since the hangup message is an ASCII string, bit 7 must be ON prior to sending the message. Hang up messages are sent to the modem automatically preceded by +++AT and with carriage return <CR> and line feed <LF> appended. XMIT looks for a correct disconnect response from the modem before it turns ON the OP_SUC output signal, noting a successful completion.

Bit	Definition
Bit 15 Tone dial modem	Set to 1 when using a Hayes compatible dial-up modem and you wish to tone dial a telephone number. The the dial message must be placed in MSG_OUT array and the length of the message in XMIT_SET.MessageLen. Tone dial numbers are sent to the modem automatically preceded by ATDT and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.
Bit 16 Initialize modem	Set to 1 when using a Hayes compatible dial-up modem and you want to initialize the modem. You program the initialization message into the MSG_OUT array and the length of the message XMIT_SET.MessageLen. All messages are sent to the modem automatically preceded by AT and with a carriage return <CR> and line feed <LF> appended. Since the initialization message is an ASCII string, bit 7 must be ON prior to sending the message.

XMIT_CFG. MessagePtr

This pointer is automatically handled by the XMIT block. It points to the beginning of the message table which is either the MSG_IN (see *MSG_IN, p. 18*) array or the MSG_OUT (see *MSG_OUT, p. 18*) array depending on the chosen XMIT function. Each array element (4x register) holds up to two ASCII characters. Each ASCII string may be up to 1024 characters in length. For example, when you want to send 10 ASCII messages out of the PLC, you must transfer the10 ASCII characters strings into the MSG_OUT array one after another after each successful operation of XMIT.

XMIT_CFG. MessageLen

You enter the length of the current message. When XMIT is sending Modbus messages for function codes 01, 02, 03, 04, 05, 06, 08, 15 and 16, the length of the message is automatically set to five. When XMIT is receving Terminated ASCII input the length of the message must be set to five or an error results. When XMIT is sending Modbus messages for function codes twenty and twenty-one, the length of the message is automatically set to six. When XMIT is sending ASCII messages, the length may be 1 ... 1024 ASCII characters per message.

XMIT_CFG.Resp TimeOut	You enter the time value in milliseconds (ms) to determine how long XMIT waits for a valid response message from a slave device (PLC, modem, etc.). In addition, the time applies to ASCII transmissions and flow control operations. When the response message is not completely formed within this specified time, XMIT issues a fault. The valid range is 0 ... 65535 ms. The timeout is initiated after the last character in the message is sent.
XMIT_CFG.Retry Limit	You enter the quantity of retries to determine how many times XMIT sends a message to get a valid response from a slave device (PLC, modem, etc.). When the response message is not completely formed within this specified time, XMIT issues a fault and a fault code. The valid range is 0 ... 65535 # of retries. This field is used in conjunction with response time-out (4x + 11).
XMIT_CFG.Start Delay	You enter the time value in milliseconds (ms) when RTS/CTS control is enabled, to determine how long XMIT waits after CTS is received before it transmits a message out of the PLC port #1. Also, you may use this register even when RTS/CTS is NOT in control. In this situation, the entered time value determines how long XMIT waits before it sends a message out of the PLC port #1. You may use this as a pre message delay timer. The valid range is 0 ... 65535 ms.
XMIT_CFG.Xm EndDelay	You enter the time value in milliseconds (ms) when RTS/CTS control is enabled, to determine how long XMIT keeps RTS asserted once the message is sent out of the PLC port #1. After the time expires, XMIT deassert RTS. Also, you may use this register even when RTS/CTS is NOT in control. In this situation, the entered time value determines how long XMIT waits after it sends a message out of the PLC port #1. You may use this as a post message delay timer. The valid range is 0 ... 65535 ms.
XMIT_CFG.Xm CurrentRetry	The value displayed here indicates the current number of retry attempts made by the XMIT block. This register is read only.

XMIT ASCII Functions

At a Glance

The XMIT function block supports the following ASCII communication functions:

- Simple ASCII Input
- Terminated ASCII Input
- ASCII String Messaging

Terminated ASCII Input Function

When XMIT_CFG.CommandWord, Bit 5 is actived for terminated ASCII Input messages, the MSG_OUT array has to contain the ASCII input definition table. The terminated ASCII definition table is five registers long. The message length XMIT_CFG.MessageLen is automatically set. The terminated ASCII input definition table is shown in the table below.

Terminated ASCII Input Definition Table

Word	High Byte	Low Byte
MSG_OUT[1]	Number of starting characters (allowed content = 0, 1, 2)	Number of terminator characters (allowed content = 1, 2)
MSG_OUT[2]	First starting character	Second starting character
MSG_OUT[3]	First terminator character	Second terminator character
MSG_OUT[4]	Not used. Destination register is automatically set to MSG_IN	
MSG_OUT[5]	Counter: counts the number of received characters written into the 4x storage destination registers	

During the process, MSG_OUT[5] holds a running count of characters written into the MSG_IN array. Once the terminated string is received the OP_SUC output on the XMIT block goes ON and MSG_OUT[5] holds the total length of the received string including the starting and terminator strings. At this point the XMIT block stills owns the port and continues to save newly received characters into the ASCII receive FIFO, because the enable ASCII receive FIFO XMIT_CFG.CommandWord, Bit 9 is ON.Using program logic, you can clear the simple ASCII input Bit before the next scan, while leaving the enable ASCII receive FIFO Bit ON. Thus, MSG_IN is NOT over written by newer FIFO data, which is still collected in the FIFO. Using program logic, you can clear both bits for enable ASCII receive FIFO (Bit 9), and terminated ASCII input (Bit 5) to return port control back to the PLC. When too many characters are written into the MSG_IN array with NO terminator detected, or the MSG_IN array is outside the allowed range for the configured PLC an error is reported in XMIT_CFG.FaultStatus. The character limit is the smaller of 1024 or two times the sizes of the MSG_IN array. We recommend you place the MSG_IN array for terminated ASCII input past all other 4x registers used in the application to avoid being over written by ASCII input in case the terminator is absent. Also, you could allocate 512 registers for the MSG_IN array.

Terminated ASCII Example

Assume that XMIT is activated with the command word Bit 9 and 5 set. Enable ASCII FIFO and terminated ASCII. The following ASCII string is received by the port: "AMScrlf$weight= 1245 GRAMScrlf$wei". Refer to the ASCII Input Definition Table that shows the contents denoted by ( ) used in this example.

Terminated ASCII Input Definition Table Example (contents)

Word	High Byte	Low Byte
MSG_OUT[1]	Number of starting characters (0x01)	Number of terminator characters (0x02)
MSG_OUT[2]	First starting character ('$')	Second starting character (Not Used)
MSG_OUT[3]	First terminator character ('cr')	Second terminator character ('if'')
MSG_OUT[4]	n.a.	n.a.
MSG_OUT[5]	Counter: counts the number of received characters written into the 4x storage destination registers	

The XMIT block becomes ACTIVE and then discards from the input FIFO the initial five characters, "AMScrlf", because they do not match the first starting character set to '$'. On the logic scan after the '$' is received, the XMIT block remains ACTIVE and it copies the '$' and subsequent characters into the MSG_IN array, updating MSG_OUT[5] of the ASCII Input Definition Table with the count done so far, as the characters come in. After the final termination character is received the output OP_SUC "Operation Successful" is activated and MSG_OUT[5] of the ASCII Input Definition Table contains the total length equal to 0x0016. The MSG_IN array contains: "$w", "ei", "gh", "t", "=", "12", "45", "G", "RA", "MS", "cflf". On the scan that the output OP_SUC "Operation Successful" is activated, the already received characters from the next message, "$wei", that came in after the termination string, remains in the ASCII input FIFO. This gives the program logic the opportunity to turn off the Terminated ASCII input before the next scan solve of XMIT for this port, keeping those characters in the FIFO until the PLC completes processing the current message, that might take several scans.

Simple ASCII Input Function

All incoming characters are placed into the MSG_IN array. Two characters are stored in each element. The first character transferred from FIFO is stored in the high byte of the first element. The second character is transferred from FIFO is stored in the low byte of the first element. The third character is stored in the high byte of the second element, and so on. The Message Length variable (XMIT_CFG.MessageLen) contains the length of the message (1 ... 1024). Therefore, the Message Length variable (XMIT_CFG.MessageLen) decreases as the characters are transferred from FIFO into the MSG_IN array. Once the entire message is transfered the Message Length variable (XMIT_CFG.MessageLen) restores its initial value and the XMITs Operation Successful output OP_SUC is activated. To enter the desired message length use the XMIT_SET.MessageLen element.

Note: When Simple ASCII Input (Bit 6) and ASCII Receive FIFO (Bit 9) remain set, new characters are constantously transferred from FIFO into the same MSG_IN array thus constantly over writing the previous characters stored into the MSG_IN array.

ASCII String Messaging

When XMIT_CFG.CommandWord, Bit 7 is actived for String Messaging, the MSG_OUT array has to contain the ASCII information to be transmitted. Two characters are stored in each element of the MSG_OUT array. The message length XMIT_SET.MessageLen has to be set to the lenght of the message to be transmitted.

XMIT Communication Functions

XMIT Command Word

The XMIT communication block performs six functions shown below. For each function certain bits of the command word (XMIT_CFG.CommandWord) must be set.

Command Word Bits

XMIT_CFG.CommandWord Functions in Relation to Bits

XMIT_CFG.Command Word Function	Command word bits that must be set to 1	Bits that MUST be set to = 0
Terminated ASCII input (Bit 5=1) *	2,3,9,10,11,12	6,7,8,13,14,15,16
Simple ASCII input (Bit 6=1) *	2,3,9,10,11,12	5,7,8,13,14,15,16
Simple ASCII output (Bit 7=1)	2,3,9,10,11,12	5,6,8,13,14,15,16
Modem output (Bit 7=1)	2,3,13,14,15,16	5,6,8,9,10,11,12 (plus one, but ONLY one, of the following bits is set to 1: 13,14,15 or 16, while the other three bits must be set to 0)
Modbus master messaging output (Bit 8=1)	2,3	5,6,7,9,10,11,12,13,14,15,16
Enable ASCII receive input FIFO ONLY (Bit 9=1)	2,3,10,11,12	5,6,7,8,13,14,15,16

Note: * When using either of these functions you MUST set Enable ASCII receive FIFO (Bit 9) to 1.

XMIT Modem Functions

At a glance

The XMIT function block allows you to communicate to a Hayes compatible modem using the functions listed in the following table:

Modem Functions

Bit in Command Word	Function
Bit 13	Pulse dial modem
Bit 14	Hangup modem
Bit 15	Tone dial modem
Bit 16	Initialize modem

Initialize Modem

Set to 1 when using a Hayes compatible dial-up modem and you want to initialize the modem. You program the initialization message into the MSG_OUT array and the length of the message into XMIT_SET.MessageLen. All messages are sent to the modem automatically preceded by AT and with a carriage return <CR> and line feed <LF> appended. Since the initialization message is an ASCII string, bit 7 must be ON prior to sending the message.

Pulse Dial Modem

Set to 1 when using a Hayes compatible dial-up modem and you wish to pulse dial a telephone number. You program the phone number into the MSG_IN array. The length of the message must be in XMIT_SET.MessageLen. Pulse dialed numbers are sent to the modem automatically preceded by ATDP and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.

Tone Dial Modem

Set to 1 when using a Hayes compatible dial-up modem and you wish to tone dial a telephone number. The the dial message must be placed in MSG_OUT array and the length of the message in XMIT_SET.MessageLen. Tone dial numbers are sent to the modem automatically preceded by ATDT and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.

Hangup Modem

Set to 1 when using a Hayes compatible dial-up modem and you want to hangup the modem. You must use program logic to turn this bit ON. Since the hangup message is an ASCII string, bit 7 must be ON prior to sending the message. Hang up messages are sent to the modem automatically preceded by +++AT and with carriage return <CR> and line feed <LF> appended. XMIT looks for a correct disconnect response from the modem before it turns ON the OP_SUC output signal, noting a successful completion.

XMIT Modbus Functions

At a Glance

The XMIT function block supports the following Modbus function codes:

- 01 ... 06
- 08
- 15 and 16
- 20 and 21

For Modbus messages, the MSG_OUT array has to contain the Modbus definition table. The Modbus definition table for Modbus function code: 01, 02, 03, 04, 05, 06, 15 and 16 is five registers long and you must set XMIT_SET.MessageLen to 5 for successful XMIT operation. The Modbus definition table is shown in the table below

Modbus Function Codes 01...06

For Modbus messages, the MSG_OUT array has to contain the Modbus definition table. The Modbus definition table for Modbus function code: 01, 02, 03, 04, 05, 06, 15 and 16 is five registers long and you must set XMIT_SET.MessageLen to 5 for successful XMIT operation. The Modbus definition table is shown in the table below

Modbus Definition Table Function Codes (01 ... 06, 15 and 16)

Content	Description
Modbus function code (MSG_OUT[1])	XMIT supports the following function codes: 01 = Read multiple coils (0x) 02 = Read multiple discrete inputs (1x) 03 = Read multiple holding registers (4x) 04= Read multiple input registers (3x) 05 = Write single coil (0x) 06 = Write single holding registers (4x) 15 = Write multiple coils (0x) 16 = Write multiple holding registers (4x)
Quantity (MSG_OUT[2])	Enter the amount of data you want written to the slave PLC or read from the slave PLC. For example, enter 100 to read 100 holding registers from the slave PLC or enter 32 to write 32 coils to a slave PLC. There is a size limitation on quantity that is dependent on the PLC model. Refer to Appendix A for complete details on limits.
Slave PLC address (MSG_OUT[3])	Enter the slave Modbus PLC address. Typically the Modbus address range is 1 ... 247. To send a Modbus message to multiple PLCs, enter 0 for the slave PLC address. This is referred to as Broadcast Mode. Broadcast Mode only supports Modbus function codes that writes data from the master PLC to slave PLCs. Broadcast Mode does NOT support Modbus function codes that read data from slave PLCs.

Content	Description
Slave PLC data area (MSG_OUT[4])	For a read command, the slave PLC data area is the source of the data. For a write command, the slave PLC data area is the destination for the data. For example, when you want to read coils (00300 ... 00500) from a slave PLC, enter 300 in this field. When you want to write data from a master PLC and place it into register (40100) of a slave PLC, enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below.
Master PLC data area (MSG_OUT[5])	For a read command, the master PLC data area is the destination for the data returned by the slave. For a write command, the master PLC data area is the source of the data. For example, when you want to write coils (00016 ... 00032) located in the master PLC to a slave PLC, enter 16 in the field. When you want to read input registers (30001 ... 30100) from a slave PLC and place the data into the master PLC data area (40100 ... 40199), enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below.

Source and Destination Data Areas for Function Codes (01 ... 06, 15 and 16)

Function Code	Master PLC Data Area	Slave PLC Data Area
03 (Read multiple 4x)	4x (destination)	4x (source)
04 (Read multiple 3x)	4x (destination)	3x (source)
01 (Read multiple 0x)	0x (destination)	0x (source)
02 (Read multiple 1x)	0x (destination)	1x (source)
16 (Write multiple 4x)	4x (source)	4x (destination)
15 (Write multiple 0x)	0x (source)	0x (destination)
05 (Write single 0x)	0x (source)	0x (destination)
06 (Write single 4x)	4x (source)	4x (destination)

When you want to send 20 Modbus messages out of the PLC, you must transfer 20 Modbus definition tables one after another into MSG_OUT after each successful operation of XMIT, or you may program 20 separate XMIT blocks and then activate them one at a time through user logic.

Modbus Function Code (08)

The Modbus definition table for Modbus function code: 08 is five registers long and you must you must set XMIT_SET.MessageLen to 5 for For Modbus messages, the MSG_OUT array has to contain the Modbus definition successful XMIT operation. The Modbus definition table is shown in the table below.

Modbus Definition Table Function Codes (08)

Content	Description
Modbus function code (MSG_OUT[1])	XMIT supports the following function code: 08 = Diagnostics
Diagnostics (MSG_OUT[2])	Enter the diagnostics subfunction code decimal value in this filed to perform the specific diagnostics function desired. The following diagnostic subfunctions are supported: Code Description 00 Return query data 01 Restart comm option 02 Return diagnostic register 03 Change ASCII input delimiter 04 Force listen only mode 05 ... 09 Reserved 10 Clear counters (& diagnostics registers in 384, 484) 11 Return bus messages count 12 Return bus comm error count 13 Return bus exception error count 14 ... 15 Not supported 16 Return slave NAK count 17 Return slave busy count 18 Return bus Char overrun count 19 ... 21 Not supported
Slave PLC address (MSG_OUT[3])	Enter the slave Modbus PLC address. Typically the Modbus address range is 1 ... 247. Function code 8 dose NOT support Broadcast Mode (Address 0)
Diagnostics function data field content (MSG_OUT[4])	You must enter the decimal value needed for the data area of the specific diagnostic subfunction. For subfunctions 02, 04, 10, 11, 12, 13, 16, 17 and 18 this value is automatically set to zero. For subfunctions 00, 01, and 03 you must enter the desired data field value. For more details, refer to Modicon Modbus Protocol Reference Guide (PI-MBUS-300).

Content	Description
Master PLC data area (MSG_OUT[5])	For all subfunctions, the master PLC data area is the destination for the data returned by the slave. You must specify a 4x register that marks the beginning of the data area where the returned data is placed. For example, to place the data into the master PLC data area starting at (40100), enter 100 in this field. Subfunction 04 does NOT return a response. For more details, refer to Modicon Modbus Protocol Reference Guide (PI-MBUS-300).

Modbus Function Codes (20, 21)

For Modbus messages, the MSG_OUT array has to contain the Modbus definition table. The Modbus definition table for Modbus function codes: 20 and 21 is six registers long and you must you must set XMIT_SET.MessageLen to 6 for successful XMIT operation. The Modbus definition table is shown in the table below.

Modbus Definition Table Function Codes (20, 21)

Content	Description
Modbus function code (MSG_OUT[1])	XMIT supports the following function codes: 20 = Read general reference (6x) 21 = Write general reference (6x)
Quantity (MSG_OUT[2])	Enter the amount of data you want written to the slave PLC or read from the slave PLC. For example, enter 100 to read 100 holding registers from the slave PLC or enter 32 to write 32 coils to a slave PLC. There is a size limitation on quantity that is dependent on the PLC model. Refer to Appendix A for complete details on limits.
Slave PLC address (MSG_OUT[3])	Enter the slave Modbus PLC address. Typically the Modbus address range is 1 ... 247. Function code 20 and 21 do NOT support Broadcast Mode (Address 0).
Slave PLC data area (MSG_OUT[4])	For a read command, the slave PLC data area is the source of the data. For a write command, the slave PLC data area is the destination for the data. For example, when you want to read registers (600300 ... 600399) from a slave PLC, enter 300 in this field. When you want to write data from a master PLC and place it into register (600100) of a slave PLC, enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below. The lowest extended register is addressed as register "zero" (600000). The lowest holding register is addressed as register "one" (400001).

Content	Description
Master PLC data area (MSG_OUT[5])	For a read command, the master PLC data area is the destination for the data returned by the slave. For a write command, the master PLC data area is the source of the data. For example, when you want to write registers (40016 ... 40032) located in the master PLC to 6x registers in a slave PLC, enter 16 in the filed. When you want to read 6x registers (600001 ... 600100) from a slave PLC and place the data into the master PLC data area (40100 ... 40199), enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below. The lowest extended register is addressed as register "zero" (600000). The lowest holding register is addressed as register "one" (400001).
File number (MSG_OUT[6])	Enter the file number for the 6x registers to be written to or read from. (1 ... 10) depending on the size of the extended register data area. 600001 is 60001 file 1 and 690001 is 60001 file 10 as viewed by the Reference Data Editor.

Source and Destination Data Areas for Function Codes (20, 21)

Function Code	Master PLC Data Area	Slave PLC Data Area
20 (Read general reference 6x)	4x (destination)	6x (source)
21 (Write general reference 6x)	4x (source)	6x (destination)

When you want to send 20 Modbus messages out of the PLC, you must transfer 20 Modbus definition tables one after another into MSG_OUT after each successful operation of XMIT, or you may program 20 separate XMIT blocks and then activate them one at a time through user logic.

FIFO and Flow Control

At a Glance

The XMIT function block allows the the user to define the use of a receive FIFO buffer, flow control and the function of received back spaces.

ASCII Receive FIFO

Setting this bit to 0 ends this function. When the FIFO receives 512 characters an internal overflow is set. When this occurs all subsequent characters are discarded, all ASCII input operations (simple and terminated) are ended, and the block returns an error until you toggle (Bit 9). When (Bit 9) is toggled, all data in the FIFO is discarded, both ASCII input control bits are ignored (Simple ASCII (Bit 6), Terminated ASCII (Bit 5)), and when no ASCII output controls are selected then the control of the port (1 or 2) is returned back to the PLC. You need to set either Terminated ASCII (Bit 5) or Simple ASCII (Bit 6) to remove the ASCII characters from FIFO for processing. No more than one of the following three bits can be set simultaneously: Terminated ASCII (Bit 5), Simple ASCII (Bit 6), or ASCII Output (Bit 7). Full duplex operation may be achieved by setting both ASCII Receive FIFO (BIT 9), and ASCII Output (Bit 7). This allows simple ASCII transmission out of the PLC while still receiving ASCII characters into FIFO. This is useful when working with dumb terminals. When ASCII Receive FIFO (Bit 9) is set none of the following ASCII output controls are allowed: Modbus Master Messaging (Bit 8), Pulse Dial Modem (Bit 13), Hangup Modem (Bit 14), Tone Dial Modem (Bit 15) and Initialize Modem (Bit 16).

Enable Back Space

When a BS is detected it is NOT stored into the MSG_IN array, in fact it deletes the previous character and thus decreases the Terminated (Bit 5) Character Counter (MSG_OUT[5]) of the ASCII Input Definition Table. In contrast, when a regular ASCII character is detected it is stored into the MSG_IN array and the Terminated (Bit 5) Character Counter of the ASCII Input Definition Table is increased.

Note: Back spaces CANNOT delete characters from an empty MSG_IN array, thus the Terminated (Bit 5) Character Counter of the ASCII Input Definition Table never goes below 0.

This special back space functionality along with internal echo enabled at the terminal are very useful for dealing with dumb terminals. A single Terminated ASCII Input XMIT block searching for "cr" is activated with ASCII Receive FIFO (Bit 9) and back space (Bit 10) set. No additional ladder logic is required while the you type and edit characters using the back space on the fly. When you type "cr" XMIT activates the bottom output "Operation Successful", and the corrected data is all lined up properly in the MSG_IN array.

Enable RTS/CTS Flow Control

The following pertains to the output mode. The XMIT state goes to BLOCKED receiving when the receiving device indicates it cannot process additional characters by setting CTS to OFF. Likewise, The XMIT state goes to UNBLOCKED when CTS is ON and the receiving devices indicates it CAN process additional characters. When transmission is UNBLOCKED and Simple ASCII Output (Bit 7) and RTS/CTS Flow Control (Bit 11) are set then the transmit output data is sent out in 16 byte packets. After all output packets are sent then the OP_SUC output on the XMIT block goes ON "Operation Successful".If during a transmission it suddenly becomes BLOCKED, only the remaining characters in the current output packet are sent, never exceeding 16 characters, and the XMIT block remains ACTIVE indefinitely. Only when the CTS in ON will the ASCII output resume sending all remaining output packets. The following pertains to the input mode. Since RTS is an output signal, it can be used independently of the ASCII output transmit process, to BLOCK or UNBLOCK sending devices. When ASCII Receive FIFO (Bit 9) is set the RTS/CTS Flow Control works in the input mode. When ASCII Receive FIFO (Bit 9) is set and neither of the two ASCII inputs are set, Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5), the received characters will fill the FIFO in which they are inserted. Mean time the RTS Flow Control (Bit 11) is ON allowing the sending device to proceed. When the FIFO is more than three quarters full with characters the RTS Control Flow (Bit 11) is cleared to BLOCK the sending device. The RTS Control Flow (Bit 11) remains cleared until either Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5) have removed enough characters from the FIFO whereby reducing it to less than one quarter full of characters at which point the RTS Control Flow (Bit 11) is tuned ON.

Note: The RTS/CTS Flow Control algorithm is different from RTS/CTS Modem Control. The former is related to full duplex receive buffer overflow. The latter deals with the transmit process gaining access to a shared transmission medium. Therefore, it is illegal to simultaneously request both of these RTS/CTS algorithms.

Note: You CANNOT select any type of RTS/CTS Flow Control (Bit 11) handshaking when the port is in RS 485 Mode (Bit 3) because these signals do NOT exist in RS 485 mode.

Enable Xon/Xoff Flow Control

The following pertains to the output mode. The XMIT state goes to BLOCKED when Xoff character is received. Likewise the XMIT state goes to UNBLOCKED when Xon character is received. In neither case will Xon or Xoff be inserted into the FIFO.When transmission is UNBLOCKED and Simple ASCII Output (Bit 7) and Xon/Xoff Flow Control (Bit 12) are set then the transmit output data is sent out in 16 byte packets. After all output packets are sent then the bottom output on the XMIT block goes ON "Operation Successful".If during a transmission it suddenly becomes BLOCKED, only the remaining characters in the current output packet are sent, never exceeding 16 characters, and the XMIT block remains ACTIVE indefinitely. Only when the next Xon character is received will the ASCII output resume sending all remaining output packets. The following pertains to the input mode. Xon/Xoff may be used to BLOCK or UNBLOCK sending devices. When ASCII Receive FIFO (Bit 9) is set the Xon/Xoff Control Flow (Bit 12) works in the input mode. When ASCII Receive FIFO (Bit 9) is set and neither of the two ASCII inputs are set, Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5), the received characters will fill the FIFO in which they are inserted.When the FIFO is more than three quarter full with characters and additional characters are received the FIFO state variable is set to send XOFF character out the serial port after a delay of up to 16 character times BLOCKING the sender and clearing the FIFO state variable. When all ASCII output functions are (Bits 8,13,14,15, and 16) OFF and the Xon/Xoff Flow Control (Bit 12) is ON the delay time defaults to 1 character time. In contrast, when all ASCII output functions are (Bits 8,13,14,15, and 16) ON and the Xon/Xoff Flow Control (Bit 12) is ON then the ASCII output is broken up into 16 byte packets. Thus, pending Xoff characters DO NOT have to wait more than 16 character times before BLOCKING the sender. Once the sender has stopped transmission, the PLC eventually removes the characters form the FIFO using either Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 7). When FIFO becomes less than one quarter full with characters the FIFO state variable is set to send XON. Thus, sending a Xon character out the serial port to UNBLOCK the sender.

Note: To prevent lockup due to a disconnected cable or other intermittent communication errors, when the sender is BLOCKED and did NOT receive the Xon character correctly we use the following algorithm. When FIFO becomes empty and no characters are subsequently received, then a steady stream of Xon characters are transmitted at the rate of once every 5 seconds.

Note: The Xon/Xoff Flow Control (Bit 12) is different from the RTS/CTS Control Flow (Bit 11). The former uses transmitted Xon and Xoff characters to prevent receive buffer overflow in full duplex mode. The latter uses hardware shaking signals to accomplish the same goal. Therefore, it is illegal to simultaneously request both of these flow control algorithms because RTS/CTS Flow Control (Bit 11) Modem Control implies a half duplex network while Xon/Xoff Flow Control (Bit 12) implies a full duplex network.

Run Time Errors

Error Messages

In case of error, the XMIT function block will generate the following runtime error:

```
ILLEGAL_CONFIG_DATA
```

This will be displayed in the **Online Event** dialog.

Subject to the value of the first error message parameter, the error message may have various origins.

- One or more variables linked to MSG_OUT, MSG_IN or CFG are not within the 4x register range
- An invalid value for the communications interface was selected at the PORT input. Authorized values are "1" and "2"
- The wrong message length was selected.
  The message length defined in the "MessageLen" component of data structure XMIT_SET at the SET input is greater than the length of the variable attached at the MSG_OUT output.

Application Example

Description

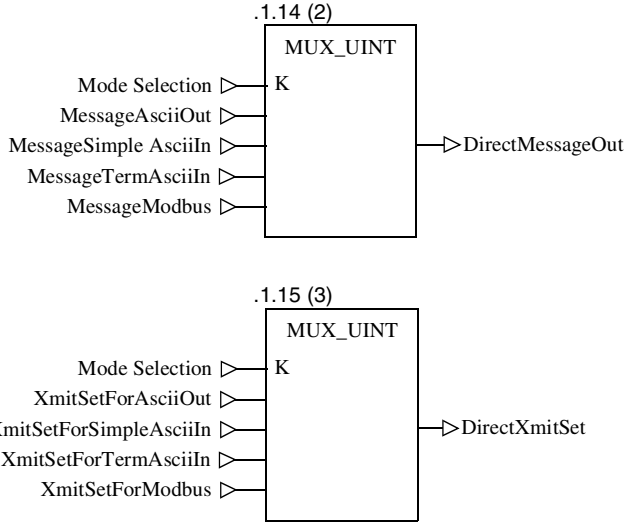
The following program is a short demo application which allows to easily switch between the four main functions of the XMIT block:

- ASCII Message Out (0)
- Simple ASCII In (1)
- Terminated ASCII In (2)
- Modbus Master (3)

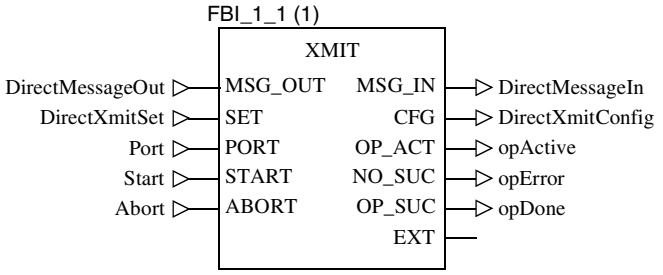
To select the function enter the appropriate number into the ModeSelection variable. A rising signal on X_Trigger activates the XMIT block by setting the Start variable 1. Start remains 1 until the function has been performed or an error occured.

IEC Section

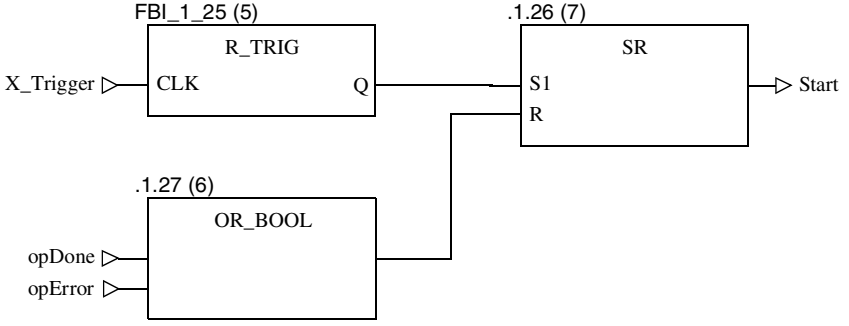
Selection of configuration data



XMIT function block



Keeps Start "on" until command finished or an error occurs



Variable Declarations

The following tables show the variables used in this example

Variable table

Variable Name	Data Type	Address	Description
Start	BOOL		Must remain ON until the XMIT has been finished
Abort	BOOL		Aborts XMIT operation
opActive	BOOL		Indicates XMIT Status
opError	BOOL		Indicates XMIT Status
opDone	BOOL		Indicates XMIT Status
Port	BYTE		Select port 1 or 2
DirectMessageOut	WordArr256	400257	Actual configuration data or data to be transmitted
DirectXmitSet	XMIT_SET	400513	Actual configuration data
DirectMessageIn	WordArr256	400001	Data received by ASCII In functions
DirectXmitConfig	XMIT_CFG	400523	Actual configuration data
X_Trigger	BOOL		Triggers the XMIT function
ModeSelection	UINT		Select the requested function 0..3
Message AsciiOut	WordArr256		Message to be transmitted by ASCII Out
MessageSimpleAsciiIn	WordArr256		(no content needed)
MessageTermAsciiIn	WordArr256		Configuration data for Terminated ASCII In
MessageModbus	WordArr256		Configuration data for Modbus
XmitSetForAsciiOut	XMIT_SET		Configuration data for ASCII Out
XmitSetForSimpleAsciiIn	XMIT_SET		Configuration data for Simple ASCII In
XmitSetForTermAsciiIn	XMIT_SET		Configuration data for Terminated ASCII In
XmitSetForModbus	XMIT_SET		Configuration data for Modbus

Înitial Values

The following tables show the initial values for the different arrays used:

Content of XmitSetForAaciiOut Data Structure

Element Name	Data Type	Address	Comment
BaudRate	WORD	9600	
DataBits	BYTE	8	
Parity	BYTE	2	
StopBits	BYTE	1	
CommandWord	WORD	512	Bit 7 set
MessageLen	WORD	16	Transmits the first 16 Characters from MessageAsciiOut array
RespTimeOut	WORD	100	
RetryLimit	WORD	100	
XmStartDelay	WORD	100	
XmEndDelay	WORD	100	

Content of XmitSetForSimpleAsciiIn Data Structure

Element Name	Data Type	Address	Comment
BaudRate	WORD	9600	
DataBits	BYTE	8	
Parity	BYTE	2	
StopBits	BYTE	1	
CommandWord	WORD	1152	Bits 6 and 9 set
MessageLen	WORD	16	opDone is set to 1 after receiving 16 characters
RespTimeOut	WORD	100	
RetryLimit	WORD	100	
XmStartDelay	WORD	100	
XmEndDelay	WORD	100	

Content of XmitSetForTermAsciiIn Data Structure

Element Name	Data Type	Address	Comment
BaudRate	WORD	9600	
DataBits	BYTE	8	
Parity	BYTE	2	
StopBits	BYTE	1	
CommandWord	WORD	2176	Bits 5 and 9 set
MessageLen	WORD	5	The DirectXmitSet.MessageLen element will be automatically set to 5 independent of this entry
RespTimeOut	WORD	100	
RetryLimit	WORD	100	
XmStartDelay	WORD	100	
XmEndDelay	WORD	100	

Content of XmitSetForModbus Data Structure

Element Name	Data Type	Address	Comment
BaudRate	WORD	9600	
DataBits	BYTE	8	RTU Mode
Parity	BYTE	2	
StopBits	BYTE	1	
CommandWord	WORD	256	Bit 8 set
MessageLen	WORD	5	For Function Codes 01...06, 15 and 16
RespTimeOut	WORD	1000	
RetryLimit	WORD	10	
XmStartDelay	WORD	100	
XmEndDelay	WORD	100	

Content of MessageAsciiOut Data Structure

Element Name	Data Type	Address	Comment
MessageAsciiOut[2]	WORD	17220	'CD' to be transmitted)
MessageAsciiOut[3]	WORD	17734	'EF'
MessageAsciiOut[4]	WORD	18248	'GH'
MessageAsciiOut[5]	WORD	18762	'IJ'
MessageAsciiOut[6]	WORD	19276	'KL'
MessageAsciiOut[7]	WORD	19790	'MN'
MessageAsciiOut[8]	WORD	20304	'OP'
MessageAsciiOut[...]	WORD	...	

Content of MessageTermAsciiIn Data Structure

Element Name	Data Type	Address	Comment
MessageAsciiOut[1]	WORD	258	0x0102 1 starting and 2 termination characters
MessageAsciiOut[2]	WORD	9216	0x2400 First starting character '$'
MessageAsciiOut[3]	WORD	3338	0x0D0A Termination characters [CR][LF]

Content of MessageModbus Data Structure

Element Name	Data Type	Address	Comment
MessageAsciiOut[1]	WORD	3	Read multiple holding registers (4x)
MessageAsciiOut[2]	WORD	32	Read 32 registers
MessageAsciiOut[3]	WORD	10	Slave PLC modbus address
MessageAsciiOut[4]	WORD	101	Start with register 40101
MessageAsciiOut[5]	WORD	701	Data destination is register 40701

XXMIT: Transmit (Compact, Momentum, Quantum)

3

At a Glance

Introduction

This chapter describes the XXMIT function block.

What's in this Chapter?

This chapter contains the following topics:

Brief Description

Function Description

The XXMIT (Transmit) function block sends Modbus messages from a "master" PLC to multiple slave PLCs or sends ASCII character strings from the PLC's Modbus slave port#1 (on Momentum PLCs also port#2 is supported) to ASCII printers and terminals. XXMIT sends these messages over telephone dialup modems, radio modems, or simply direct connections. XXMIT performs general ASCII input functions in the communication mode including simple ASCII and terminated ASCII. You may import and export ASCII or binary data into your PLC. The block has builtin diagnostics that checks to make sure no other XXMIT blocks are active in the PLC on the same port. Within the XXMIT block control inputs allows you to control the communications link between the PLC and DCE (Data Communication Equipment) devices attached to Modbus port #1 or port#2 of the PLC. The XXMIT block does NOT activate the port LED when it is transmitting data.

Note: EN and ENO should NOT be used with the XXMIT, otherwise the output parameters may freeze.

Restrictions

The following restrictions apply to the XXMIT function block:

XXMIT does not support::

- ASCII string conversion
- copy and compare functions
- Port Status functions

Note: Momentum only supports one Stopbit.

Note: Port 2 only supported by Momentum PLCs

Software and Hardware Required

Software

The XXMIT function block requires the following software

- A minimum of Concept 2.2 Service Release 2
- IEC exec version

Hardware

The following hardware is **not** supported by the XXMIT function block:

- PLCs which do not support IEC languages
- Soft PLC
- All Atrium PLCs
- IEC Simulator

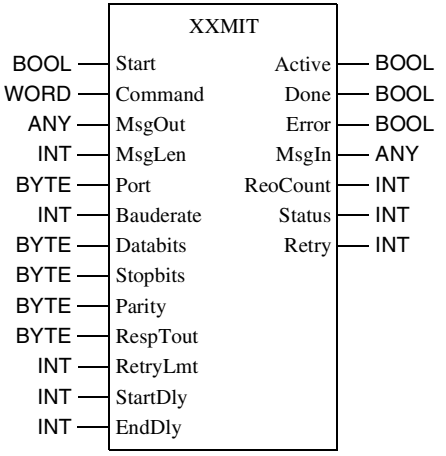
Memory Requirements

The usage of one or more XXMIT EFBs in an IEC application consumes approximately 15.5 KByte program (code) memory.For each instance of this EFB included in the user program, additional data memory between 2.5 and 3 Kbyte is allocated.

Representation

Symbol

Representation of the Block



Parameter Description

Description of the block parameter

Parameters	Data type	Significance
Start	BOOL	Value of 1 starts XXMIT operation
Command	WORD	Specifies the command to be performed
MsgOut	ANY	Message to be sent
MsgLen	INT	Message length of output message
Port	BYTE	Selection of communications interface
Baudrate	INT	Baudrate
Databits	BYTE	Databits
Stopbits	BYTE	Stopbits
Parity	BYTE	Parity
RespTout	INT	Time to wait for a valid response
RetryLmt	INT	Number of retries until receiving a valid response
StartDly	INT	Waiting time before message transmit.
EndDly	INT	Waiting time after message transmit
Active	BOOL	Value of 1 indicates that an XXMIT operation is in progress
Done	BOOL	Value of 1 indicates that the XXMIT operation has been completed successfully
Error	BOOL	Value of 1 indicates that an error has ocured or that the current XXMIT operation is terminated
MsgIn	ANY	Incoming message
RecCount	INT	Displaythe number of received characters
Status	INT	Display a fault code generated by the XXMIT block
Retry	INT	Indicates the current number of retry attempts made by the XXMIT block

Detailed Parameter Description

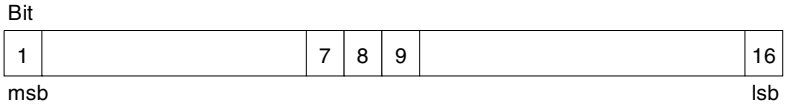
Start

A rising edge at Start triggers the XXMIT operation. The value of 1 must be applied until the operation has finished or until an error has occurred.

Command

The XXMIT interprets each bit of the command word as a function to perform. If bit 7 and 8 are on simultaneously or if any two or more of bits 13, 14, 15 or 16 are on simultaneously or if bit 7 is not on when bits 13, 14, 15, or 16 are on error 129 will be generated. For more details refer to *XXMIT Communication Functions, p. 58*. The individual bit definitions are shown in the table below.

Command Word Layout



XXMIT Command Word Bit Definitions

Bit	Definition
Bit 1 (msb)	Reserved
Bit 2 Enable RTS/ CTS modem control	Set to 1 when a DCE connected to the PLC requires hardware handshaking using RTS/CTS control. This bit may be used in conjunction with values contained in StartDly and EndDly. Start of transmission delay keeps RTS asserted for the time in StartDly (ms) before XXMIT sends a message out of PLC port. Likewise, end of transmission delay keeps RTS asserted for the time in EndDly (ms) after XXMIT has finished sending a message out of the PLC port. Once the end of transmission delay expires XXMIT de-assert RTS.
Bit 3 Enable RS485 mode	Set to 1 when the selected port should operate in RS485 mode. Otherwise it defaults to 0, which is RS232 mode. When using port 2 of a Momentum PLC in RS485 mode with Modbus Messaging, make sure to use exactly the same parameters (baudrate, databits, stopbits, parity) for the XXMIT block as configured for that port.
Bit 4	Reserved
Bit 5 Terminated ASCII input	Set to 1 to remove and discard all characters from FIFO until the starting string is matched, then these starting characters and subsequent characters are written into MsgIn until the terminator sequence is matched. The terminator string is also written into the MsgIn. Refer to *Terminated ASCII Input Function, p. 59* for more details.
Bit 6 Simple ASCII input	Set to 1 to remove the ASCII characters from FIFO for writing into MsgIn array. Refer to *Simple ASCII Input Function, p. 61* for more details.

Bit	Definition
Bit 7 Enable ASCII string messaging	Set to 1 when you want to send ASCII messages out of the PLC. XXMIT sends ASCII strings up to 1024 characters in length. You program the ASCII message into the MsgOut. Only use Bit 7 OR Bit 8, do not try to use both.
Bit 8 Enable Modbus messaging	Set to 1 when you want to send Modbus messages out of the PLC. Modbus messages may be in either RTU or ASCII formats. When data bits=8, XXMIT uses Modbus RTU format. When data bits=7, XXMIT uses Modbus ASCII format. Only use Bit 7 OR Bit 8, do not try to use both.
Bit 9 Enable ASCII receive FIFO	Set to 1 to allow the XXMIT block to take control over the selected port (1 or 2) from the PLC. The block begins to receive ASCII characters into an empty 512 byte circular FIFO. Refer to *ASCII Receive FIFO, p. 73* for more details.
Bit 10 Enable back space	Set to 1 to allow special handling of ASCII back space character (BS, 8Hex) when using either Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5). If Bit 10 is set, each back space character will NOT be stored into MsgIn. Refer to *Enable Back space, p. 73* for more details.
Bit 11 Enable RTS/CTS flow control	Set to 1 to allow full duplex hardware flow control using the RTS and CTS handshaking signals for ASCII massaging. The RTS/CTS operates in both the input and output modes. Refer to *Enable RTS/CTS Flow Control, p. 74* for more details.
Bit 12 Enable Xon/Xoff flow control	Set to 1 to allow full duplex software flow control using the ASCII Xon character (DC1, 11 Hex) and the ASCII Xoff character (DC3, 13 Hex). The Xon/Xoff operates in both the input and output modes. Refer to *Enable Xon/Xoff Flow Control, p. 75* for more details.
Bit 13 Pulse dial modem	Set to 1 when using a Hayes compatible dial-up modem and you wish to pulse dial a telephone number. You program the phone number into the MsgOut. The length of the message must be in MsgLen. Pulse dialed numbers are sent to the modem automatically preceded by ATDP and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.
Bit 14 hangup modem	Set to 1 when using a Hayes compatible dial-up modem and you want to hangup the modem. You must use user logic to turn this bit ON. Since the hangup message is an ASCII string, bit 7 must be ON prior to sending the message. Hang up messages are sent to the modem automatically preceded by +++AT and with carriage return <CR> and line feed <LF> appended. XXMIT looks for a correct disconnect response from the modem before it turns ON the Done output signal, noting a successful completion.

Bit	Definition
Bit 15 Tone dial modem	Set to 1 when using a Hayes compatible dial-up modem and you wish to tone dial a telephone number. You program the phone number into the MsgOut. The length of the message must be in MsgLen. Tone dial numbers are sent to the modem automatically preceded by ATDT and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.
Bit 16 Initialize modem	Set to 1 when using a Hayes compatible dial-up modem and you want to initialize the modem. You program the initialization message into MsgOut and the length of the message into MsgLen. All messages are sent to the modem automatically preceded by AT and with a carriage return <CR> and line feed <LF> appended. Since the initialization message is an ASCII string, bit 7 must be ON prior to sending the message.

MsgOut

MsgOut contains the message data to be transferred, for example, ASCII characters for an ASCII transfer, definition of termination characters for terminated ASCII input or Modbus templates for Modbus master messages.

The data type that must be assigned to the parameter has to match the requirements of the function to be performed. The data type of the MsgOut parameter must be equal to the data type of the MsgIn field.

Note: MsgOut and MsgIn are of Data Type ANY. It is preferrable to use a Byte Array. Different from the XMIT Block, ASCII messages are stored in byte order, allowing for easy handling, for example, through assigning a string as an initial value.

Note: For Modbus Messaging MsgOut must be a field of words. The minimum size of the array is WordArr9

MsgLen

You must enter the length of the current message according to the selected XXMIT function.

The following table gives an overview for Modbus and ASCII functions:

XXMIT function	Subfunction	Message Length
Modbus Messaging	01, 02, 03, 04, 05, 06, 08, 15, 16	5
Modbus Messaging	20, 21	6
Terminated ASCII Input		5
Simple ASCII Input		1...1024.
ASCII String Messaging		1...1024. The selected length must match the size of the array assigned to MsgOut. Otherwise you get error 129.

Port

Port specifies the communications interface. The only authorized values are the values 1 and 2. Port 2 is only available on the Momentum PLC.

Baudrate

XXMIT supports the following data rates: 50, 75, 110, 134, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 19200. To configure a data rate, enter its decimal number. When an invalid data rate is entered, the block displays an illegal configuration error (error code 127) in the XXMIT Status element.

Databits

XXMIT supports the following data bits: 7 and 8. To configure a data bit size, enter its decimal number into this element. Modbus messages may be sent in ASCII mode or RTU mode. ASCII mode requires 7 data bits, while RTU mode requires 8 data bits. When sending ASCII character message you may use either 7 or 8 data bits. When an invalid data bit is entered, the block displays an illegal configuration error (error code 127) in the XXMIT Status element. For more details on Modbus message formats refer to *Modicon Modbus Protocol Reference Guide* (PI MBUS 300).

Stopbits

XXMIT supports one or two stop bits. Enter a decimal of either: 1 = one stop bit, or 2 = two stop bits. When an invalid stop bit is entered, the block displays an illegal configuration error (error code 127) in the XXMIT Status element.

Parity

XXMIT supports the following parity: none, odd and even. Enter a decimal of either: 0 = no parity, 1 = odd parity, or 2 = even parity. When an invalid parity is entered, the block displays an illegal configuration error (error code 127) in the XXMIT Status element.

RespTout You enter the time value in milliseconds (ms) to determine how long XXMIT waits for a valid response message from a slave device (PLC, modem, etc.). In addition, the time applies to ASCII transmissions and flow control operations. When the response message is not completely formed within this specified time, XXMIT issues a fault. The valid range is 0 ... 32767 ms. The timeout is initiated after the last character in the message is sent.

RetryLmt You enter the quantity of retries to determine how many times XXMIT sends a message to get a valid response from a slave device (PLC, modem, etc.). When the response message is not completely formed within this specified time, XXMIT issues a fault and a fault code. The valid range is 0 ... 32767 # of retries. This field is used in conjunction with RespTout.

StartDly You enter the time value in milliseconds (ms) when RTS/CTS control is enabled, to determine how long XXMIT waits after CTS is received before it transmits a message out of the PLC port. Also, you may use this register even when RTS/CTS is NOT in control. In this situation, the entered time value determines how long XXMIT waits before it sends a message out of the PLC port. You may use this as a pre message delay timer. The valid range is 0 ... 32767 ms.

EndDly You enter the time value in milliseconds (ms) when RTS/CTS control is enabled, to determine how long XXMIT keeps RTS asserted once the message is sent out of the PLC port. After the time expires, XXMIT deassert RTS. Also, you may use this register even when RTS/CTS is NOT in control. In this situation, the entered time value determines how long XXMIT waits after it sends a message out of the PLC port. You may use this as a post message delay timer. The valid range is 0 ... 32767 ms.

Note: On RS 485 communication the transmit signal is held to '1' during the EndDly time. On 2-wire connections any characters coming from the communication partner will be lost.Therefore set EndDly to 0 ms if this function is not needed.

Retry The value displayed here indicates the current number of retry attempts made by the XXMIT block. This element is read only.

Active A value of 1 indicates that an XXMIT operation is in progress.

Done A value of 1 indicates that the XXMIT operation has been completed successfully.

Error A value of 1 indicates that an error has occurred or that the current XXMIT operation is terminated.

MsgIn MsgIn contains the incoming message data, for terminated ASCII input or simple ASCII input.

The data type that must be assigned to the parameter has to match the requirements of the function to be performed. The data type must be equal to the type of the MsgOut field.

RecCount This element displays the number of received characters.

Status This element displays a fault code generated by the XXMIT block.

A complete list is shown in the table below.

Fault Status

Fault Code	Fault Description
1	Modbus exception - Illegal function
2	Modbus exception - Illegal data address
3	Modbus exception - Illegal data value
4	Modbus exception - Slave device failure
5	Modbus exception - Acknowledge
6	Modbus exception - Slave device busy
7	Modbus exception -Negative acknowledge
8	Modbus exception -Memory parity error
9 ... 99	Reserved
100	Slave PLC data area cannot equal zero
101	Master PLC data area cannot equal zero
102	Coil (0x) not configured
103	Master PLC 4x Holding Register area not configured
104	Data length cannot equal zero
105, 106	Reserved
107	Transmit message time-out (This error is generated when the UART cannot complete a transmission in 10 seconds or less. This error bypasses the retry counter and will activate the error output on the first error).
108	Undefined error
109	Modem returned ERROR
110	Modem returned NO CARRIER
111	Modem returned NO DIALTONE

Fault Code	Fault Description
112	Modem returned BUSY
113	Invalid LRC checksum from the slave PLC (see Note below)
114	Invalid CRC checksum from the slave PLC (see Note below)
115	Invalid Modbus function code
116	Modbus response message time-out (see Note below)
117	Modem reply time-out
118	XXMIT could not gain access to PLC communications port #1 or port #2
119	XXMIT could not enable PLC port receiver
120	XXMIT could not set PLC UART
121	Reserved
122	Invalid Port
123	Reserved
124	Undefined internal state
125	Broadcast mode not allowed with this Modbus function code
126	DCE did not assert CTS
127	Illegal configuration (data rate, data bits, parity, or stop bits)
128	Unexpected response received from Modbus slave (see Note below)
129	Illegal command word setting
130	Command word changed while active
131	Invalid character count
132	Reserved
133	ASCII input FIFO overflow error
134	Invalid number of start characters or termination characters
135...149	Reserved
150	Either configured port already taken by another instance of the XXMIT or the configured port is not supported on that PLC
151	MsgOut is smaller than 12 Byte while 'Modbus Master Messaging' function is selected
152	Variable connected to MsgOut is smaller than the value of the MsgLen parameter while 'ASCII String Messaging' is selected
153	Variable connected to MsgIn is smaller than the value of the MsgLen parameter while either 'Terminated ASCII Input' or 'SimpleASCII Input' is selected

Note: This fault code does happen if the Modbus slave responds too fast.
In case the used Modbus slave is a Modicon PLC , please check the `Modbus Port Setup` of that PLC's configuration.

XXMIT Communication Functions

XXMIT Command Word

The XXMIT communication block performs six functions shown below. For each function certain bits of the Command word must be set.

Command Word Bits

Command Word Functions in Relation to Bits

Function	Command word bits that may be set to 1	Bits that MUST be set to = 0
Terminated ASCII input (Bit 5=1) [1]	2,3,9,10,11,12	6,7,8,13,14,15,16
Simple ASCII input (Bit 6=1) *	2,3,9,10,11,12	5,7,8,13,14,15,16
Simple ASCII output (Bit 7=1)	2,3,9,10,11,12	5,6,8,13,14,15,16
Modem output (Bit 7=1)	2,3,13,14,15,16	5,6,8,9,10,11,12 (plus one, but ONLY one, of the following bits is set to 1: 13,14,15 or 16, while the other three bits must be set to 0)
Modbus master messaging output (Bit 8=1)	2,3	5,6,7,9,10,11,12,13,14,15,16

Note: [1] When using either of these functions you MUST set Enable ASCII receive FIFO (Bit 9) to 1. Bit 1 (MSB) and Bit 4 are reserved. (See Table *Command, p. 51*)

XXMIT ASCII Functions

At a Glance

The XXMIT function block supports the following ASCII communication functions

- Terminated ASCII Input
- Simple ASCII Input
- ASCII String Messaging

Terminated ASCII Input Function

When Bit 5 of the Command Word is activated for terminated ASCII Input messages, the MsgOut array has to contain the ASCII input definition table. Depending of which datatype you selected for MsgOut, the terminated ASCII definition table consists of three words or 6 byte. The terminated ASCII input definition table is shown in the table below.

Terminated ASCII Input Definition Table (Datatype WordArray)

Word	High Byte	Low Byte
MsgOut[1]	Number of starting characters (allowed content = 0, 1, 2)	Number of terminator characters (allowed content = 1, 2)
MsgOut[2]	First starting character	Second starting character
MsgOut[3]	First terminator character	Second terminator character

Terminated ASCII Input Definition Table (Datatype ByteArray)

Byte	Function
MsgOut[1]	length of termination string (1 or 2)
MsgOut[2]	length of start string (0 or 1 or 2)
MsgOut[3]	2nd start character
MsgOut[4]	1st start character
MsgOut[5]	2nd termination character
MsgOut[6]	1st termination character

During the process, RecCount holds a running count of characters written into the MsgIn array. Once the terminated string is received the Done output on the XXMIT block goes ON and RecCount holds the total length of the received string including the starting and terminator strings. At this point the XXMIT block still owns the port and continues to save newly received characters into the ASCII receive FIFO, because the enable ASCII receive FIFO Command Word, Bit 9 is ON.

Using program logic, you can clear the simple ASCII input Bit before the next scan, while leaving the enable ASCII receive FIFO Bit ON. Thus, MsgIn is NOT over written by newer FIFO data, which is still collected in the FIFO. Using program logic, you can clear both bits for enable ASCII receive FIFO (Bit 9), and terminated ASCII input (Bit 5) to return port control back to the PLC.

When too many characters are written into the MsgIn array with NO terminator detected, or the MsgIn array is outside the allowed range for the configured PLC an error is reported in Status. The character limit is the smaller of 1024 or two times the sizes of the MsgIn array.

Terminated ASCII Example

Assume that XXMIT is activated with the command word Bit 9 and 5 set. Enable ASCII FIFO and terminated ASCII. The following ASCII string is received by the port: "AMScrlf$weight = 1245 GRAMScrlf$wei". Refer to the ASCII Input Definition Table that shows the contents denoted by ( ) used in this example.

Terminated ASCII Input Definition Table (content Datatype Byte Array)

Byte	Content
MsgOut[1]	Number of starting characters (0x01)
MsgOut[2]	Number of terminator characters (0x02)
MsgOut[3]	Second starting character (Not Used)
MsgOut[4]	First starting character ('$')
MsgOut[5]	Second terminator character ('lf")
MsgOut[6]	First terminator character ('cr')

Terminated ASCII Input Definition Table Example (content for Datatype Word Array)

Word	High Byte	Low Byte
MsgOut[1]	Number of starting characters (0x01)	Number of terminator characters (0x02)
MsgOut[2]	First starting character ('$')	Second starting character (Not Used)
MsgOut[3]	First terminator character ('cr')	Second terminator character ('lf")

The XXMIT block becomes ACTIVE and then discards from the input FIFO the initial five characters, "AMScrlf", because they do not match the first starting character set to '$'. On the logic scan after the '$' is received, the XXMIT block remains ACTIVE and it copies the '$' and subsequent characters into the MsgIn array, updating RecCount with the count done so far, as the characters come in. After the final termination character is received the output Done is activated and MsgLen contains the total length equal to 22 characters (0x0016). The MsgIn array contains: "$weight = 1245 GRAMScrlf" as Byte Array (or: "$w", "ei", "gh", "t ", "= ", "12", "45", " G", "RA", "MS", "crlf" if using a Word Array). On the scan that the output Done is activated, the already received characters from the next message, "$wei", that came in after the termination string, remains in the ASCII input FIFO. This gives the program logic the opportunity to turn off the Terminated ASCII input before the next scan solve of XXMIT for this port, keeping those characters in the FIFO until the PLC completes processing the current message, that might take several scans.

Simple ASCII Input Function

All incoming characters are placed into the MsgIn array. If MsgIn is defined as Byte Array (as recommended), the incomming characters are simply stored first character into first array element, second character into second and so on.If MsgIn is defined as WordArray, two characters are stored in each element. The first character is stored in the high byte of the first element. The second character is stored in the low byte of the first element. The third character is stored in the high byte of the second element, and so on. The Message Length variable (MsgLen) contains the length of the message (1 ... 1024 characters).

Note: When Simple ASCII Input (Bit 6) and ASCII Receive FIFO (Bit 9) remain set, new characters are continuously transferred from FIFO into the same MsgIn array thus constantly over writing the previous characters stored into the MsgIn array.

ASCII String Messaging

When Command Word, Bit 7 is activated for String Messaging, the MsgOut array has to contain the ASCII information to be transmitted. The message length MsgLen has to be set to the length of the message to be transmitted.

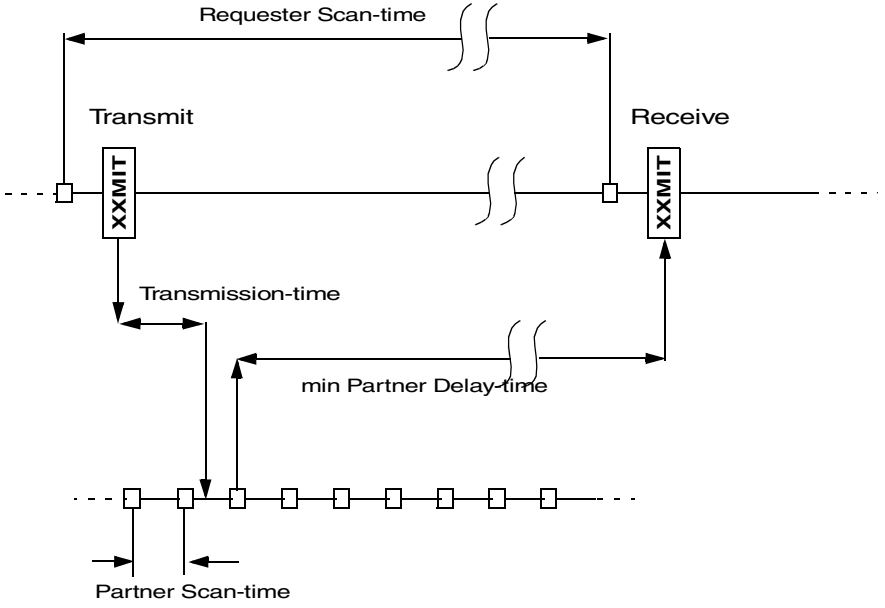
As mentioned in *Detailed Parameter Description, p. 51*, MsgOut may be of any datatype. For ASCII String Messaging the type ByteArray reflects best the nature of strings: First Byte contains first character and so on. (See *Simple ASCII Send, p. 81*)

Transmit - Receive Transition

If your application requires to receive an answer from another device after transmitting a message (request - response), you need the XXMIT function block to switch from transmit mode to receive mode in order to read the communication partner's response. The earliest point in time to switch the XXMIT function block from transmit to receive is the cycle following the transmit operation. It is the responsibility of the user to ensure that the response is delayed by at least one cycle time of the requesting PLC to avoid communication failure.

The transmit delay on the communication partner's side is especially important in cases of long cycle times on the requester's side and fast communication partners.

Timing considerations for the Partner Delay-time:



From the above figure (not to scale) you can estimate the influence of the three different times Requester Scan-time, Transmission-time and Partner Scan-time on the required Partner Delay-time. As the requester's and partner's scans are asynchronous, the Partner Scan-time should not be taken into account. The transmission-time depends on telegram length and baud rate. A message with 18 characters at 9600 baud takes 14 ms. The main contribution obviously comes from the Requester Scan-time. So even the minimum Partner Delay-time could be less than the Requester Scan-time, we recommend to use the Requester Scan-time as the minimum Partner Delay-time to ensure a sound communication..

XXMIT Modem Functions

At a glance

The XXMIT function block allows you to communicate to a Hayes compatible modem using the functions listed in the following table:

Modem Functions

Bit in Command Word	Function
Bit 13	Pulse dial modem
Bit 14	Hangup modem
Bit 15	Tone dial modem
Bit 16	Initialize modem

Initialize Modem

Set Bit 16 of the command word to 1 when using a Hayes compatible dial-up modem and you want to initialize the modem. You program the initialization message into the MsgOut array and the length of the message into MsgLen. All messages are sent to the modem automatically preceded by AT and with a carriage return <CR> and line feed <LF> appended. Since the initialization message is an ASCII string, bit 7 must be ON prior to sending the message

Pulse Dial Modem

Set Bit 13 of the command word to 1 when using a Hayes compatible dial-up modem and you wish to pulse dial a telephone number. You program the phone number into the MsgOut array. The length of the message must be in MsgLen. Pulse dialed numbers are sent to the modem automatically preceded by ATDP and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.

Tone Dial Modem

Set Bit 15 of the command word to 1 when using a Hayes compatible dial-up modem and you wish to tone dial a telephone number. You program the phone number into the MsgOut array. The length of the message must be in MsgLen. Tone dialed numbers are sent to the modem automatically preceded by ATDT and with carriage return <CR> and line feed <LF> appended. Since the dial message is an ASCII string, bit 7 must be ON prior to sending the number to be dialed.

Hangup Modem

Set Bit 14 of the command word to 1 when using a Hayes compatible dial-up modem if you want to hangup the modem. You must use program logic to turn this bit ON. Since the hangup message is an ASCII string, bit 7 must be ON prior to sending the message. Hang up messages are sent to the modem automatically preceded by +++AT and with carriage return <CR> and line feed <LF> appended. XXMIT looks for a correct disconnect response from the modem before it turns ON the Done output signal, noting a successful completion.

XXMIT Modbus Functions

At a Glance

The XXMIT function block supports the following Modbus function codes:.

- 01 ... 06 and 15 ... 16
- 08
- 20 and 21

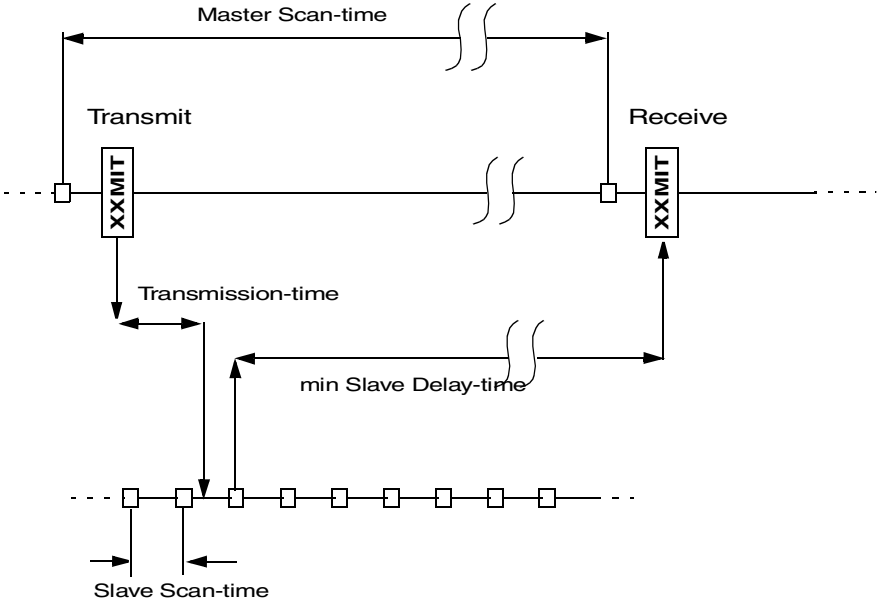
Note: When using port 2 of a Momentum PLC in RS485 mode with Modbus Messaging, make sure to use exactly the same parameters (baudrate, databits, stopbits, paritty) for the XXMIT block as configured for that port.

Transmit - Receive Transition

Except broadcast messages all Modbus functions require the XXMIT function block to switch from transmit mode to receive mode in order to read the slave's response. The XXMIT function block switches from transmit to receive in the cycle following the transmit operation. It is the responsibility of the user to ensure that the slave's response is delayed by at least one cycle time of the master to avoid communication failure.

The transmit delay on the slave side is especially important in cases of long master cycle times and fast slaves.

Timing considerations for the Slave Delay-time:



From the above figure (not to scale) you can estimate the influence of the three different times Master Scan-time, Transmission-time and Slave Scan-time on the required Slave Delay-time. As the master and slave scans are asynchronous, the Slave Scan-time should not be taken into account. The transmission-time depends on telegram type, baud rate and protocol. A standard Read request at 9600 baud using ASCII protocol for example takes 14 ms. The main contribution obviously comes from the Master Scan-time. So even the minimum Slave Delay-time could be less than the Master Scan-time, we recommend to use the Master Scan-time as the minimum Slave Delay-time to ensure a sound communication.

Note: For Quantum, Compact and Momentum PLCs you can specify the delay time in the Modbus Port Settings dialog. The delay time can be specified between 10 and 1000 ms, which will automatically be rounded up to be divisible by 10. You must enter the required delay-time **plus** 10 ms. For example to have a 110 ms delay you must enter 120 in this field.

Modbus Function Codes (01 ... 06, 15 and 16)

For Modbus messages, the MsgOut array has to contain the Modbus definition table. This has to be defined as a field of words. The Modbus definition table for Modbus function code: 01, 02, 03, 04, 05, 06, 15 and 16 is five registers long and you must set MsgLen to 5 for successful XXMIT operation. The Modbus definition table is shown in the table below.

Modbus Definition Table Function Codes (01 ... 06, 15 and 16)

Content	Description
Modbus function code (MsgOut[1])	XXMIT supports the following function codes: 01 = Read multiple coils (0x) 02 = Read multiple discrete inputs (1x) 03 = Read multiple holding registers (4x) 04= Read multiple input registers (3x) 05 = Write single coil (0x) 06 = Write single holding registers (4x) 15 = Write multiple coils (0x) 16 = Write multiple holding registers (4x)
Quantity (MsgOut[2])	Enter the amount of data you want written to the slave PLC or read from the slave PLC. For example, enter 100 to read 100 holding registers from the slave PLC or enter 32 to write 32 coils to a slave PLC. There is a size limitation on quantity that is dependent on the PLC model. Refer to Appendix A for complete details on limits.
Slave PLC address (MsgOut[3])	Enter the slave Modbus PLC address. Typically the Modbus address range is 1 ... 247. To send a Modbus message to multiple PLCs, enter 0 for the slave PLC address. This is referred to as Broadcast Mode. Broadcast Mode only supports Modbus function codes that writes data from the master PLC to slave PLCs. Broadcast Mode does NOT support Modbus function codes that read data from slave PLCs.
Slave PLC data area (MsgOut[4])	For a read command, the slave PLC data area is the source of the data. For a write command, the slave PLC data area is the destination for the data. For example, when you want to read coils (00300 ... 00500) from a slave PLC, enter 300 in this field. When you want to write data from a master PLC and place it into register (40100) of a slave PLC, enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below.

Content	Description
Master PLC data area (MsgOut[5])	For a read command, the master PLC data area is the destination for the data returned by the slave. For a write command, the master PLC data area is the source of the data. For example, when you want to write coils (00016 ... 00032) located in the master PLC to a slave PLC, enter 16 in the field. When you want to read input registers (30001 ... 30100) from a slave PLC and place the data into the master PLC data area (40100 ... 40199), enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below.

Source and Destination Data Areas for Function Codes (01 ... 06, 15 and 16)

Function Code	Master PLC Data Area	Slave PLC Data Area
03 (Read multiple 4x)	4x (destination)	4x (source)
04 (Read multiple 3x)	4x (destination)	3x (source)
01 (Read multiple 0x)	0x (destination)	0x (source)
02 (Read multiple 1x)	0x (destination)	1x (source)
16 (Write multiple 4x)	4x (source)	4x (destination)
15 (Write multiple 0x)	0x (source)	0x (destination)
05 (Write single 0x)	0x (source)	0x (destination)
06 (Write single 4x)	4x (source)	4x (destination)

When you want to send 20 Modbus messages out of the PLC, you must transfer 20 Modbus definition tables one after another into MsgOut after each successful operation of XXMIT, or you may program 20 separate XXMIT blocks and then activate them one at a time through user logic.

Modbus Function Code (08)

For Modbus messages, the MsgOut array has to contain the Modbus definition table. This has to be defined as a field of words. The Modbus definition table for Modbus function code: 08 is five registers long and you must set MsgLen to 5 for successful XXMIT operation. The Modbus definition table is shown in the table below.

Modbus Definition Table Function Codes (08)

Content	Description	
Modbus function code (MsgOut[1])	XXMIT supports the following function code: 08 = Diagnostics	
Diagnostics (MsgOut[2])	Enter the diagnostics subfunction code decimal value in this field to perform the specific diagnostics function desired. The following diagnostic subfunctions are supported:	
	Code	Description
	00	Return query data
	01	Restart comm option
	02	Return diagnostic register
	03	Change ASCII input delimiter
	04	Force listen only mode
	05 ... 09	Reserved
	10	Clear counters (& diagnostics registers in 384, 484)
	11	Return bus messages count
	12	Return bus comm error count
	13	Return bus exception error count
	14 ... 15	Not supported
	16	Return slave NAK count
	17	Return slave busy count
	18	Return bus Char overrun count
	19 ... 21	Not supported
Slave PLC address (MsgOut[3])	Enter the slave Modbus PLC address. Typically the Modbus address range is 1 ... 247. Function code 8 does NOT support Broadcast Mode (Address 0)	
Diagnostics function data field content (MsgOut[4])	You must enter the decimal value needed for the data area of the specific diagnostic subfunction. For subfunctions 02, 04, 10, 11, 12, 13, 16, 17 and 18 this value is automatically set to zero. For subfunctions 00, 01, and 03 you must enter the desired data field value. For more details, refer to *Modicon Modbus Protocol Reference Guide (PI-MBUS-300)*.	

Content	Description
Master PLC data area (MsgOut[5])	For all subfunctions, the master PLC data area is the destination for the data returned by the slave. You must specify a 4x register that marks the beginning of the data area where the returned data is placed. For example, to place the data into the master PLC data area starting at (40100), enter 100 in this field. Subfunction 04 does NOT return a response. For more details, refer to *Modicon Modbus Protocol Reference Guide (PI-MBUS-300)*.

Modbus Function Codes (20, 21)

For Modbus messages, the MsgOut array has to contain the Modbus definition table. This has to be defined as a field of words. The Modbus definition table for Modbus function codes: 20 and 21 is six registers long and you must set MsgLen to 6 for successful XXMIT operation. The Modbus definition table is shown in the table below.

Modbus Definition Table Function Codes (20, 21)

Content	Description
Modbus function code (MsgOut[1])	XXMIT supports the following function codes: 20 = Read general reference (6x) 21 = Write general reference (6x)
Quantity (MsgOut[2])	Enter the amount of data you want written to the slave PLC or read from the slave PLC. For example, enter 100 to read 100 holding registers from the slave PLC or enter 32 to write 32 coils to a slave PLC. There is a size limitation on quantity that is dependent on the PLC model.
Slave PLC address (MsgOut[3])	Enter the slave Modbus PLC address. Typically the Modbus address range is 1 ... 247. Function code 20 and 21 do NOT support Broadcast Mode (Address 0).
Slave PLC data area (MsgOut[4])	For a read command, the slave PLC data area is the source of the data. For a write command, the slave PLC data area is the destination for the data. For example, when you want to read registers (600300 ... 600399) from a slave PLC, enter 300 in this field. When you want to write data from a master PLC and place it into register (600100) of a slave PLC, enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below. The lowest extended register is addressed as register "zero" (600000). The lowest holding register is addressed as register "one" (400001).

Content	Description
Master PLC data area (MsgOut[5])	For a read command, the master PLC data area is the destination for the data returned by the slave. For a write command, the master PLC data area is the source of the data. For example, when you want to write registers (40016 ... 40032) located in the master PLC to 6x registers in a slave PLC, enter 16 in the field. When you want to read 6x registers (600001 ... 600100) from a slave PLC and place the data into the master PLC data area (40100 ... 40199), enter 100 in this field. Depending on the type of Modbus command (write or read), the source and destination data areas must be as defined in the Source and Destination Data Areas table below. The lowest extended register is addressed as register "zero" (600000). The lowest holding register is addressed as register "one" (400001).
File number (MsgOut[6])	Enter the file number for the 6x registers to be written to or read from. (1 ... 10) depending on the size of the extended register data area. 600001 is 60001 file 1 and 69 0001 is 60001 file 10 as viewed by the Reference Data Editor.

Source and Destination Data Areas for Function Codes (20, 21)

Function Code	Master PLC Data Area	Slave PLC Data Area
20 (Read general reference 6x)	4x (destination)	6x (source)
21 (Write general reference 6x)	4x (source)	6x (destination)

When you want to send 20 Modbus messages out of the PLC, you must transfer 20 Modbus definition tables one after another into MsgOut after each successful operation of XXMIT, or you may program 20 separate XXMIT blocks and then activate them one at a time through user logic.

FIFO and Flow Control

At a glance

The XXMIT function block allows the the user to define the use of a receive FIFO buffer, flow control and the function of received back spaces.

ASCII Receive FIFO

Setting Bit 9 of the command word to 0 ends this function. When the FIFO receives 512 characters an internal overflow is set. When this occurs all subsequent characters are discarded, all ASCII input operations (simple and terminated) are ended, and the block returns an error until you toggle (Bit 9). When (Bit 9) is toggled, all data in the FIFO is discarded, both ASCII input control bits are ignored (Simple ASCII (Bit 6), Terminated ASCII (Bit 5)), and when no ASCII output controls are selected then the control of the serial port (1 or 2) is returned back to the PLC.

You need to set either Terminated ASCII (Bit 5) or Simple ASCII (Bit 6) to remove the ASCII characters from FIFO for processing. No more than one of the following three bits can be set simultaneously: Terminated ASCII (Bit 5), Simple ASCII (Bit 6), or ASCII Output (Bit 7).

Full duplex operation may be achieved by setting both ASCII Receive FIFO (BIT 9), and ASCII Output (Bit 7). This allows simple ASCII transmission out of the PLC while still receiving ASCII characters into FIFO. This is useful when working with dumb terminals. When ASCII Receive FIFO (Bit 9) is set none of the following ASCII output controls are allowed: Modbus Master Messaging (Bit 8), Pulse Dial Modem (Bit 13), Hangup Modem (Bit 14), Tone Dial Modem (Bit 15) and Initialize Modem (Bit 16).

Enable Back Space

When a backspace (BS) is detected it is NOT stored into the MsgIn array, in fact it deletes the previous character and thus decreases the RecCount Character Counter. In contrast, when a regular ASCII character is detected it is stored in the MsgIn array and the RecCount Character Counter is increased.

Note: Back spaces CANNOT delete characters from an empty MsgIn array, thus the RecCount Character Counter never goes below 0.

This special back space functionality along with internal echo enabled at the terminal are very useful for dealing with dumb terminals. A single Terminated ASCII Input XXMIT block searching for "cr" is activated with ASCII Receive FIFO (Bit 9) and back space (Bit 10) set. No additional program logic is required while you type and edit characters using the back space on the fly. When you type "cr" XXMIT activates the Done output, and the corrected data is all lined up properly in the MsgIn array.

Enable RTS/CTS Flow Control

The following pertains to the output mode. The XXMIT state goes to BLOCKED receiving when the receiving device indicates it cannot process additional characters by setting CTS to OFF. Likewise, The XXMIT state goes to UNBLOCKED when CTS is ON and the receiving devices indicates it CAN process additional characters.

When transmission is UNBLOCKED and Simple ASCII Output (Bit 7) and RTS/CTS Flow Control (Bit 11) are set then the transmit output data is sent out in 16 byte packets. After all output packets are sent then the Done output on the XXMIT block goes ON to indicate "Operation Successful".

If during a transmission it suddenly becomes BLOCKED, only the remaining characters in the current output packet are sent, never exceeding 16 characters, and the XXMIT block remains ACTIVE indefinitely. Only when the CTS in ON will the ASCII output resume sending all remaining output packets.

The following pertains to the input mode. Since RTS is an output signal, it can be used independently of the ASCII output transmit process, to BLOCK or UNBLOCK sending devices. When ASCII Receive FIFO (Bit 9) is set the RTS/CTS Flow Control works in the input mode. When ASCII Receive FIFO (Bit 9) is set and neither of the two ASCII inputs are set, Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5), the received characters will fill the FIFO in which they are inserted. In the mean time, the RTS Flow Control (Bit 11) is ON allowing the sending device to proceed.

When the FIFO (512 characters) is more than three quarters full with characters the RTS Control Flow (Bit 11) is cleared to BLOCK the sending device. The RTS Control Flow (Bit 11) remains cleared until either Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5) have removed enough characters from the FIFO whereby reducing it to less than one quarter full of characters at which point the RTS Control Flow (Bit 11) is turned ON.

Note: The RTS/CTS Flow Control algorithm is different from RTS/CTS Modem Control. The former is related to full duplex receive buffer overflow. The latter deals with the transmit process gaining access to a shared transmission medium. Therefore, it is illegal to simultaneously request both of these RTS/CTS algorithms.

Note: You CANNOT select any type of RTS/CTS Flow Control (Bit 11) handshaking when the port is in RS 485 Mode (Bit 3) because these signals do NOT exist in RS 485 mode.

Enable Xon/Xoff Flow Control

The following pertains to the output mode. The XXMIT state goes to BLOCKED when an Xoff character is received. Likewise the XXMIT state goes to UNBLOCKED when an Xon character is received. In neither case will Xon or Xoff be inserted into the FIFO.

When transmission is UNBLOCKED and Simple ASCII Output (Bit 7) and Xon/Xoff Flow Control (Bit 12) are set then the transmit output data is sent out in 16 byte packets. After all output packets are sent the Done output on the XXMIT block goes ON.

If during a transmission it suddenly becomes BLOCKED, only the remaining characters in the current output packet are sent, never exceeding 16 characters, and the XXMIT block remains ACTIVE indefinitely. Only when the next Xon character is received will the ASCII output resume sending all remaining output packets.

The following pertains to the input mode. Xon/Xoff may be used to BLOCK or UNBLOCK sending devices. When ASCII Receive FIFO (Bit 9) is set the Xon/Xoff Control Flow (Bit 12) works in the input mode. When ASCII Receive FIFO (Bit 9) is set and neither of the two ASCII inputs are set, Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 5), the received characters will fill the FIFO in which they are inserted.

When the FIFO is more than three quarter full with characters and additional characters are received the FIFO state variable is set to send XOFF characters out the serial port after a delay of up to 16 character times BLOCKING the sender and clearing the FIFO state variable.

When all ASCII output functions (Bits 8,13,14,15, and 16) are OFF and the Xon/Xoff Flow Control (Bit 12) is ON the delay time defaults to 1 character time. In contrast, when all ASCII output functions (Bits 8,13,14,15, and 16) are ON and the Xon/Xoff Flow Control (Bit 12) is ON then the ASCII output is broken up into 16 byte packets. Thus, pending Xoff characters DO NOT have to wait more than 16 character times before BLOCKING the sender.

Once the sender has stopped transmission, the PLC eventually removes the characters from the FIFO using either Simple ASCII Input (Bit 6) or Terminated ASCII Input (Bit 7).

When FIFO becomes less than one quarter full with characters the FIFO state variable is set to send XON, thus, sending an Xon character out the serial port to UNBLOCK the sender.

Note: To prevent lockup due to a disconnected cable or other intermittent communication errors, when the sender is BLOCKED and did NOT receive the Xon character correctly we use the following algorithm. When FIFO becomes empty and no characters are subsequently received, then a steady stream of Xon characters are transmitted at the rate of once every 5 seconds.

Note: The Xon/Xoff Flow Control (Bit 12) is different from the RTS/CTS Control Flow (Bit 11). The former uses transmitted Xon and Xoff characters to prevent receive buffer overflow in full duplex mode. The latter uses hardware hand-shaking signals to accomplish the same goal. Therefore, it is illegal to simultaneously request both of these flow control algorithms because RTS/CTS Flow Control (Bit 11) Modem Control implies a half duplex network while Xon/Xoff Flow Control (Bit 12) implies a full duplex network.

Run Time Errors

Error Messages

In case of error, the XXMIT function block will generate the following runtime error:

`E_EFB_WORLD_INTERFACE`

This will be displayed in the **Online Event** dialog.

Subject to the value of the first error message parameter, the error message may have various origins.

- An invalid communications interface was selected.
  An invalid value for the communications interface was selected at the Port input. Authorized values are 1 and 2 for Momentum PLCs, all other platforms only 1.
- Selected port is already taken by another instance of XXMIT.
- Either an invalid value for Baudrate/Stopbits/Databits has been used or the variables connected to MsgIn or MsgOut do not provide enough memory for the configured XXMIT operation.

Application Example

Description

The following program is a short demo application with four instances of the XXMIT block showing the four main functions:

- Modbus Master
- Simple ASCII In
- ASCII Message Out
- Terminated ASCII In

Modbus Master

The following Modbus Master operation is a read request to a slave device connected to port 1 of the master:

- Read slave's 4:0001 to 4:00010
- into local 4:00011 to 4:00020

The Slave must be set up with the following port parameters:

- 9600 baud
- 8 data bits
- 1 stop bit
- even parity (2)

The Master uses settings from the XXMIT function block

Variable declaration for Modbus Master

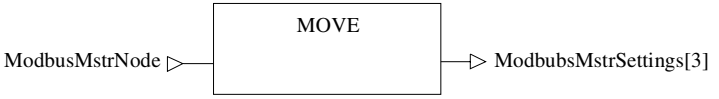
The following table shows the variables used in the Modbus Master example:

Variable Name	Data Type	Initial Value	Comment
StartModbusMstr	BOOL		
ModbusMstrActive	BOOL		
ModbusMstrCommand	WORD	16#0100	Bit 8 set
ModbusMstrDone	BOOL		
ModbusMstrError	BOOL		
ModbusMstrNode	WORD		
ModbusMstrSettings ModbusMstrSettings[1] ModbusMstrSettings[2] ModbusMstrSettings[3] ModbusMstrSettings[4] ModbusMstrSettings[5] ModbusMstrSettings[6] ...	WordArr9	 3 10 1 11	 Modbus Code: Read multiple registers Amount of Registers to read Slave Modbus address Source register Destination Register not used
ModbusMstrStatus	INT		
ModbusMstrNode	WORD		Enter Slave address
ModbusMstrErrorCounter	INT		
ModbusMstrDoneCounter	INT		

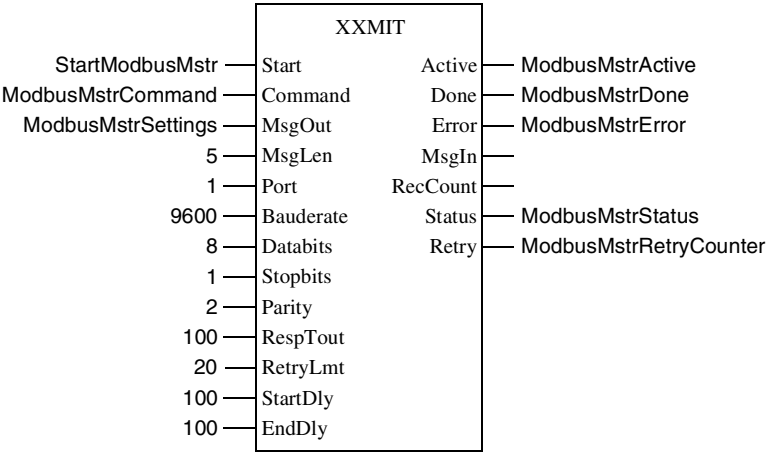
IEC Section for Modbus Master

Program the following in an FBD section:

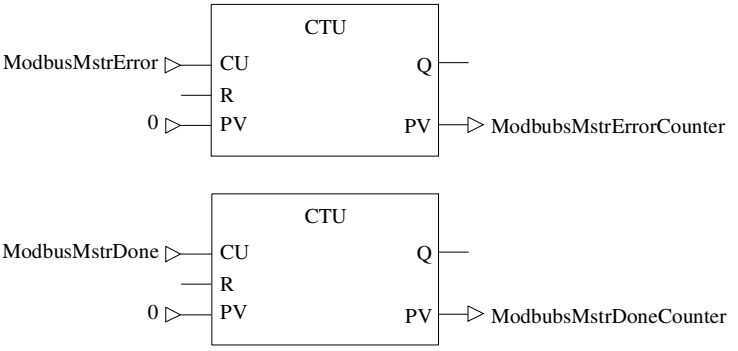
Slave node address assignment



Assignments to the XXMIT function block:



Count errors and successes



Simple ASCII Receive

Receives whatever comes into port 1. The receive buffer's length is assigned as 'SimpleReceiveLength', which has an initial value of 10.

Received characters are in MsgIn array, number of received characters in RecCount.

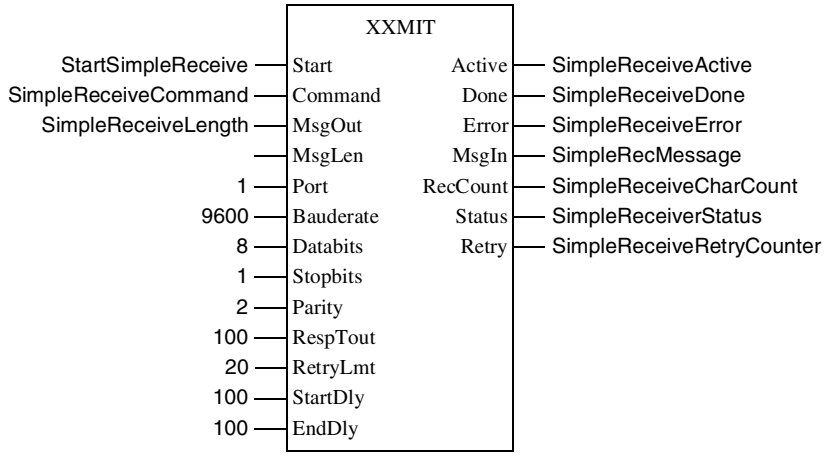
Variable declaration for Simple ASCII Receive

The following table shows the variables used in the Simple ASCII Receive example:

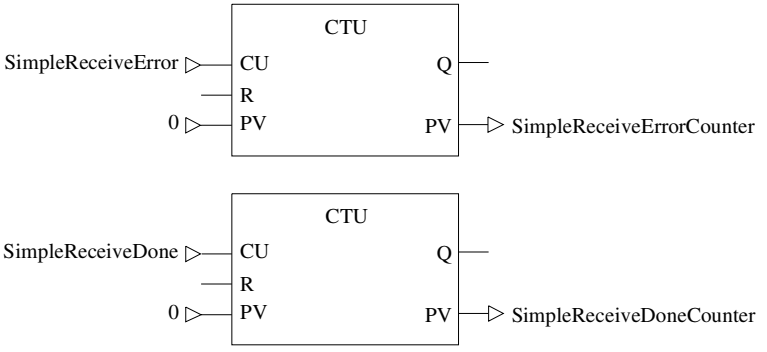
Variable Name	Data Type	Initial Value	Comment
StartSimpleReceive	BOOL		
SimpleReceiveActive	BOOL		
SimpleReceiveCharCounter	INT		
SimpleReceiveCommand	WORD	16#0480	Bits 6 and 9 set. FIFO enabled
SimpleReceiveDone	BOOL		
SimpleReceiveError	BOOL		
SimpleReceiveLength	INT	10	
SimpleReceiveRetryCounter	INT		
SimpleReceiveStatus	INT		
SimpleRecMessage	ByteArr12		
SimpleReceiveDoneCounter	INT		
SimpleReceiveErrorCounter	INT		

IEC Section for Simple ASCII Receive

Program the following in an FBD section:



Count errors and successes



Simple ASCII Send

Sends a simple ASCII message out off port 1, the message is 'Hello World!!'

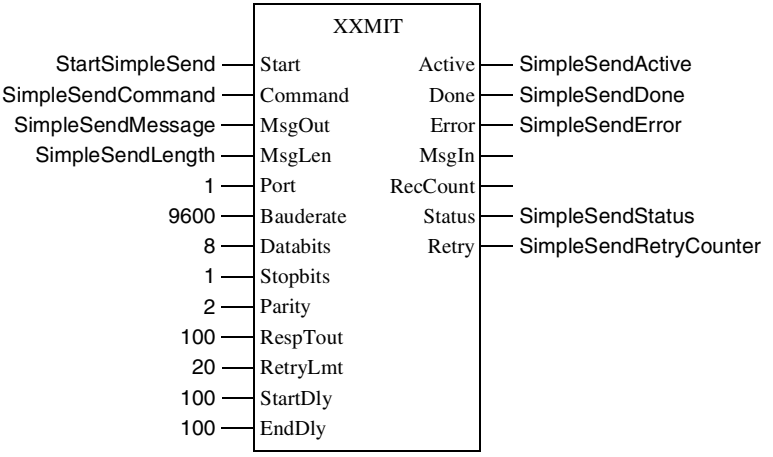
Variable declaration for Simple ASCII Send

The following table shows the variables used in the Simple ASCII Send example:

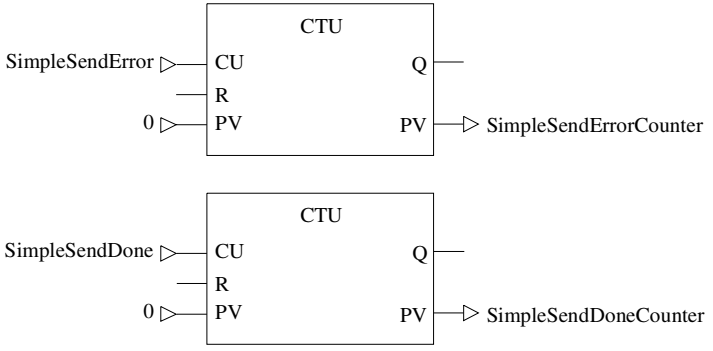
Variable Name	Data Type	Initial Value	Comment
StartSimpleSend	BOOL		
SimpleSendActive	BOOL		
SimpleSendCommand	WORD	16#0200	Bit 7 set
SimpleSendDone	BOOL		
SimpleSendError	BOOL		
SimpleSendLength	INT	14	Number of characters to send
SimpleSendMessage	ByteArr36		'Hello World !!'
SimpleSendMessage[1]		16#48	
SimpleSendMessage[2]		16#65	
SimpleSendMessage[3]		16#6C	
SimpleSendMessage[4]		16#6C	
SimpleSendMessage[5]		16#6F	
SimpleSendMessage[6]		16#20	
SimpleSendMessage[7]		16#57	
SimpleSendMessage[8]		16#6F	
SimpleSendMessage[9]		16#72	
SimpleSendMessage[10]		16#6C	
SimpleSendMessage[11]		16#64	
SimpleSendMessage[12]		16#20	
SimpleSendMessage[13]		16#21	
SimpleSendMessage[14]		16#21	
SimpleSendRetryCounter	INT		
SimpleSendStatus	INT		
SimpleSendDoneCounter	INT		
SimpleSendErrorCounter	INT		

IEC Section for Simple ASCII Send

Program the following in an FBD section:



Count errors and successes



Terminated ASCII Receive

After receiving the 'starting characters' "AB", the function block puts all received characters into the receive buffer MsgIn. The receiver will stop when the 'finishing characters' "CD" are received, whereby the "Done" output will be set, to indicate the successfull completion. The max. length of the receive buffer is assigned as "TermReceiveLength", which is set to an initial value of 20 in this example.

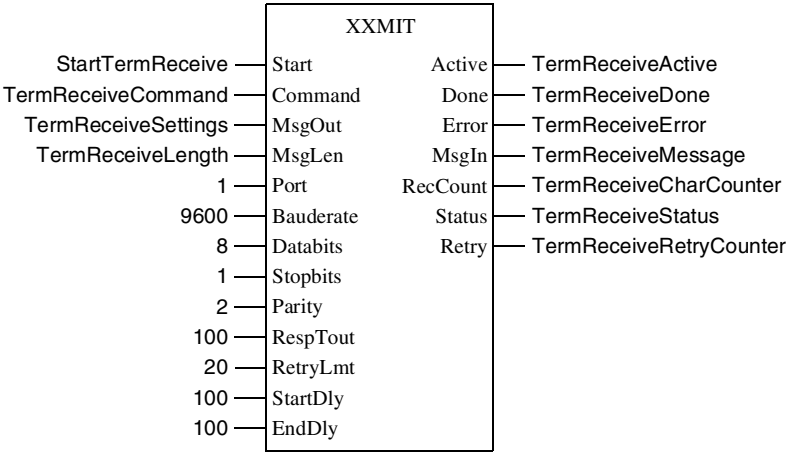
Variable declaration for Terminated ASCII Receive

The following table shows the variables used in the Terminated ASCII Receive example:

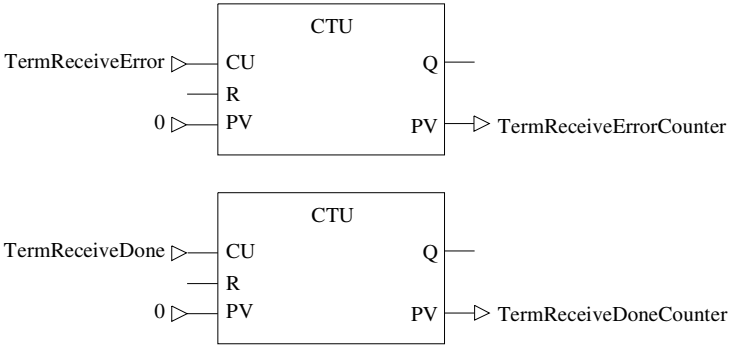
Variable Name	Data Type	Initial Value	Comment
StartTermReceive	BOOL		
TermReceiveActive	BOOL		
TermReceiveCharCounter	INT		
TermReceiveCommand	WORD	16#0880	Bits 5 and 9 set. FIFO enabled
TermReceiveDone	BOOL		
TermReceiveError	BOOL		
TermReceiveLength	INT	20	
TermReceiveMessage	ByteArr36		Received characters
TermReceiveRetryCounter	INT		
TermReceiveSettings	ByteArr36		
TermReceiveSettings[1]		16#02	length of termination string (1 or 2)
TermReceiveSettings[2]		16#02	length of start string (0, 1 or 2)
TermReceiveSettings[3]		16#41	2nd start character
TermReceiveSettings[4]		16#42	1st start character
TermReceiveSettings[5]		16#43	2nd termination character
TermReceiveSettings[6]		16#44	1st termination character
TermReceiveStatus	INT		
TermReceiveDoneCounter	INT		
TermReceiveErrorCounter	INT		

IEC Section for Terminated ASCII Receive

Program the following in an FBD section:



Count errors and successes



Entering Strings as initial values

The Variable Editor of Concept allows you to easily enter Strings as initial values into byte arrays.

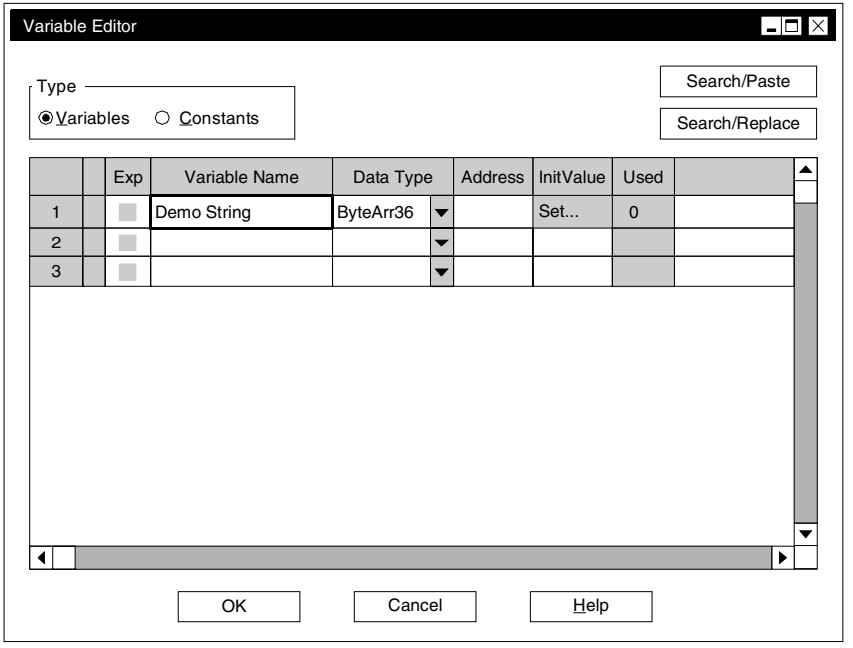
The following part gives a short describtion of how to define a variable 'DemoString' as 'ByteArr36' and enter a string 'My Text ! ' as initial value.

Open the Variable Editor

From the main menu select:

`Project -> Variable Editor.`

Variable Editor



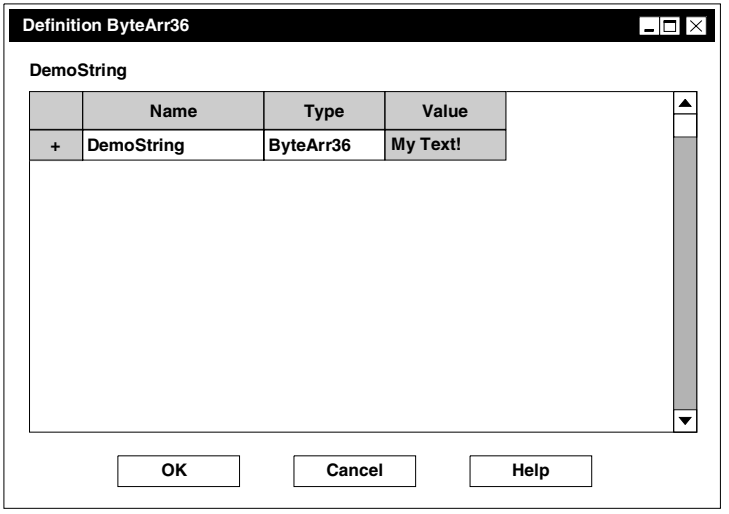
Define new variable

Enter the new variables name in the 'Variable Name' field. As data type select 'ByteArrxx' (xx depends on the size of your message). In the 'InitValue' field a 'Set...' button appears.

Enter text as initial value

Click on the 'Set...' button and open the definition window. Double clicking into the value field brings up a cursor and allows you to enter your text.

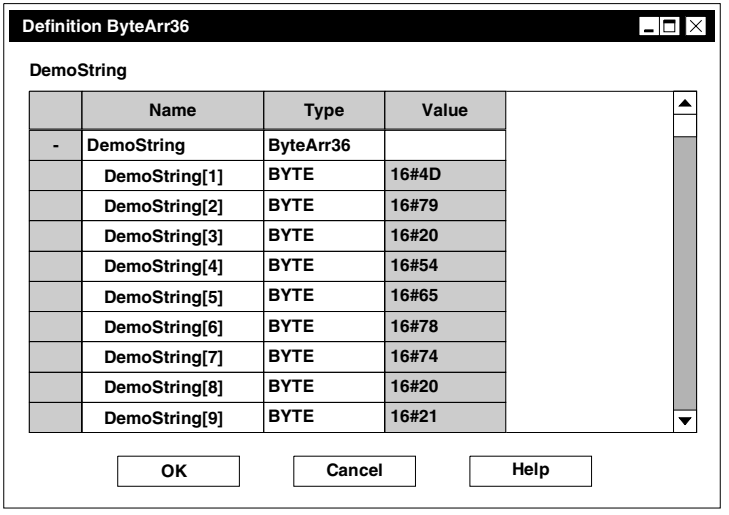
Definition ByteArr



Look at Array Elements

Click on the '+' button in front of the variables name and open the view onto all array elements. The value column shows the ASCII code representation of the entered characters as hexadecimal numbers.

Elements of the Byte Array



RTXMIT: Full Duplex Transmit (Compact, Momentum, Quantum)

4

At a Glance

Introduction

This chapter describes the RTXMIT function block.

What's in this Chapter?

This chapter contains the following topics:

Brief Description

Function Description

The function block provides full duplex communication through the local Modbus port. On Momentum PLCs the second local Modbus port is supported as well.

The function block combines two main functions into one, these are simple message reception and simple message transmission.

Note: EN and ENO should NOT be used with the RTXMIT, otherwise the output parameters may freeze.

Restrictions

The RTXMIT does **not** support Modbus protocol or modem functions.

Software and Hardware Required

Software

The RTXMIT function block requires the following software

- A minimum of Concept 2.5 Service Release 2
- IEC exec (delivered with Concept V2.5 SR2 or later)

Hardware

The following hardware is **not** supported by the RTXMIT function block:

- PLCs which do not support IEC languages
- Soft PLC
- All Atrium PLCs
- IEC Simulator

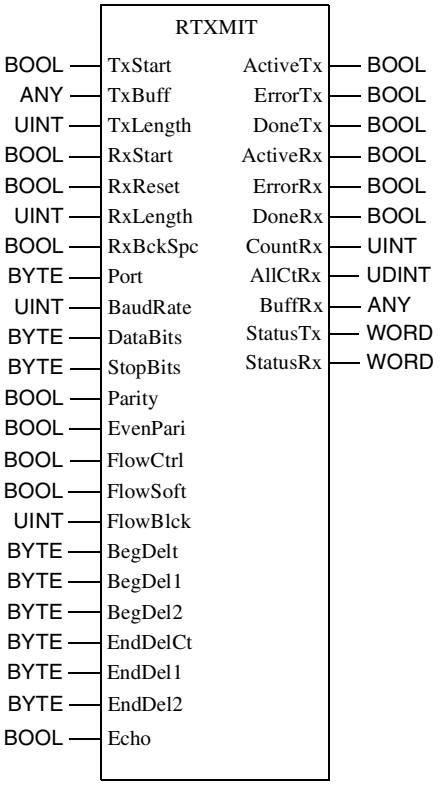
Memory Requirements

The usage of one or more RTXMIT EFBs in an IEC application consumes approximately 5KByte program (code) memory. For each instance of this EFB included in the user program, additional data memory of 200 byte is allocated.

Representation

Symbol

Representation of the Block



Parameter Description

Parameter Description

Description of the block parameter

Parameters	Data type	Significance
TxStart	BOOL	On a rising edge (FALSE->TRUE) the EFB begins with the send operation. This operation would work concurrently to an ongoing reception. If this parameter transitions from TRUE to FALSE an ongoing transmission will be aborted without any error being generated. After a transmission process completed (with or without success) a new process won't be triggered before the next rising edge happening to TxStart.
TxBuff	ANY	A variable of any datatype, it contains the 'to be sent' character stream in Intel format.
TxLength	UINT	This parameter specifies the full amount of characters to be sent from TxBuff. Without the use of data flowcontrol (RTS/ CTS or XON/XOFF), the amount of characters to be sent from TxBuff may not exceed 1024. With data flow control being activated TxLength may go as high as 2^16, as FlowBlck specifies the number of characters being transmitted with one message frame.
RxStart	BOOL	On a rising edge (FALSE->TRUE) the EFB begins with the receive operation. This operation would work concurrently to an ongoing transmission. In case this parameter carries the value TRUE after the reception process completed (DoneTx = TRUE), following characters being received won't be stored in RxBuff anymore. A new reception process won't be triggerd before the next rising edge happing to RxStart.
RxReset	BOOL	If TRUE, the following stream of characters being received will be stored at the begin of BuffRx. Also output parameter CountRx will be set to zero. At the same time current values of input parameters RxLength, Strt_Cnt, Strt_Dl1, Strt_Dl2, End_Cnt, End_Dl1, End_Dl2, RxBckSpc will be used from then on.
RxLength	UINT	Max. number of characters to be received. In case this value exceeds the size of BuffRx no error will be generated, but the size of BuffRx will be used instead. After the given number of characters has been received the output parameter DoneRx transitions to TRUE, and the receive operation will end at that time.

Parameters	Data type	Significance
RxBckSpc	BOOL	While this parameter is being set to TRUE a received character of value 8 (backspace) will cause the one character being received before the backspace to be overwritten by the character being received after the backspace. Also, in this mode the output CountRx will decrease its value with each backspace being received, till it's 0. The EFB will consider the value of RxBckSpc only while RxStart transitions from FALSE to TRUE or while RxReset is TRUE (whereby RxStart needs to be TRUE at that time).
Port	BYTE	Local port number (1 or 2) The 2nd port is supported on Momentum PLCs only. **Note:** On Momentum PLCs the EFB will switch to RS485 if the assigned port has been configured as such, otherwise the port will be run in RS232 mode.
Baudrate	UINT	Bits per second for transmission and reception, allowed values are: 50, 75, 110, 134, 150, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 19200
DataBits	BYTE	Databits per transmitted and received character (8 or 7)
StopBits	BYTE	Stopbits per transmitted and received character (1 or 2)
Parity	BOOL	If TRUE, parity check will be enabled (odd or even depends on EvenPari). If FALSE no parity check will be used.
EvenPari	BOOL	If TRUE and Parity = TRUE, even parity check will be used. If FALSE and Parity = TRUE, odd parity check will be used.
FlowCtrl	BOOL	If TRUE, the next triggered transmission will consider either RTS/CTS or XON/XOFF (depends on FlowSoft)for data flow control. Receive operations won't use data flow control, since the PLC internal buffer is big enough (512 byte) to avoid losing any character between two PLC scans.
FlowSoft	BOOL	If TRUE, the data flow of transmissions will be controled by using the XON/XOFF handshaking method.

Parameters	Data type	Significance
FlowBlck	UINT	Used only if FlowCtrl equals TRUE! This parameter specifies the number of characters being sent as one frame as soon as the transmitter obtains permission to sent through the selected data flow control mechanism. If FlowBlck is set to 0 the EFB will internally use 1 instead, as this is the minimum amount of characters to be sent in one frame. If FlowBlck is set to a higher value than TxLength the EFB will internally use TxLength instead, as this is the maximum amount of characters to be sent in one frame. In order to increase data throughput (only one frame can be transmitted per PLC scan) the value assigned to FlowBlck needs to be increased.
BegDelCt	BYTE	Number of start delimiter. This parameter assigns how many characters are being used for the start delimiter. Allowed values are: 0, 1, 2. In case the value exceeds 2 the EFB won't generate an error, but would use the max. of 2 instead.
BegDel1	BYTE	This is the first (of max. 2) character of the start delimiter.
BegDel2	BYTE	This is the second (of max. 2) character of the start delimiter.
EndDelCt	BYTE	Number of end delimiter. This parameter assigns how many characters are being used for the end delimiter. Allowed values are: 0, 1, 2. In case the value exceeds 2 the EFB won't generate an error, but would use the max. of 2 instead.
EndDel1	BYTE	This is the first (of max. 2) character of the end delimiter.
EndDel2	BYTE	This is the second (of max. 2) character of the end delimiter.
Echo	BOOL	If TRUE, all characters being received during transmission will be discarded. In RS485 2-wire mode this parameter would need to be set TRUE, otherwise each just-transmitted character would be received immediately afterwards.
ActiveTx	BOOL	If TRUE, a previously initiated send operation is still ongoing.
ErrorTx	BOOL	If TRUE, a previously initiated send operation failed, StatusTx. In such case StatusTx will carry an error code that helps to identify the reason for a failure.
DoneTx	BOOL	If TRUE, a previously initiated send operation finsihed with success.
ActiveRx	BOOL	If TRUE, a previously initiated receive operation is still ongoing.
ErrorRx	BOOL	If TRUE, a previously initiated receive operation failed. In such case StatusRx will carry an error code that helps to identify the reason for a failure.

Parameters	Data type	Significance
DoneRx	BOOL	If TRUE, a previously initiated receive operation finsihed with success.
CountRx	UINT	Number of characters being received since last initiated receive operation. This output parameter will be set back to 0 after RxReset has been set to TRUE. Also this number does decrease upon reception of a backspace character in case RxBckSpc is set to TRUE.
AllCtRx	UDINT	Number of ALL characters being received since the last rising edge happened at RxStart. This output will also stay at its value after RxReset has been set to TRUE.
BuffRx	ANY	A variable of any datatype, it is used to store the received characters in Intel format.
StatusTx	WORD	Will be 0 if there's no error for the send operation, otherwise error code (see *Runtime Errors, p. 96*).
StatusRx	WORD	Will be 0 if there's no error for the receive operation, otherwise error code (see *Runtime Errors, p. 96*).

Port-Parameters

New port parameters being assigned to input parameters Port, Baudrate, DataBits, StopBits, Parity and EvenPari will only be used after both parts of the EFB (receiver and transmitter) have been shutdown (TxStart = FALSE and RxStart = FALSE) and at least one of them has been (re-)started again.

Runtime Errors

Error code (at StatusTx and StatusRx)

Error code (at StatusTx and StatusRx)

Error Code	Description
0	No error, either EFB is turned off completely (TxStart and RxStart are FALSE) or the ongoing process works properly.
8003 (hex)	The assigned Modbus port does not exist (>1 on Quantum and Compact, >2 on Momentum). or Another EFB is using the assigned Modbus port already.
8304 (hex)	The assigned Modbus port is used by a 984-Loadable (like XXMIT).
8305 (hex)	Illegal baudrate being assigned.
8307 (hex)	Illegal number of data bits being assigned.
8308 (hex)	Illegal number of stop bits being assigned.

Application Example

Description

The following program is a short demo application which shows the implementation of a full duplex transmission with RTXMIT in the Structured Text language. The message to be transmitted has to be in `TxBuff`, the received message is in `BuffRx`.