

GE
Intelligent Platforms

Programmable Control Products

PACSystems* RSTi

Modbus Network Adapter

User's Manual, GFK-2799

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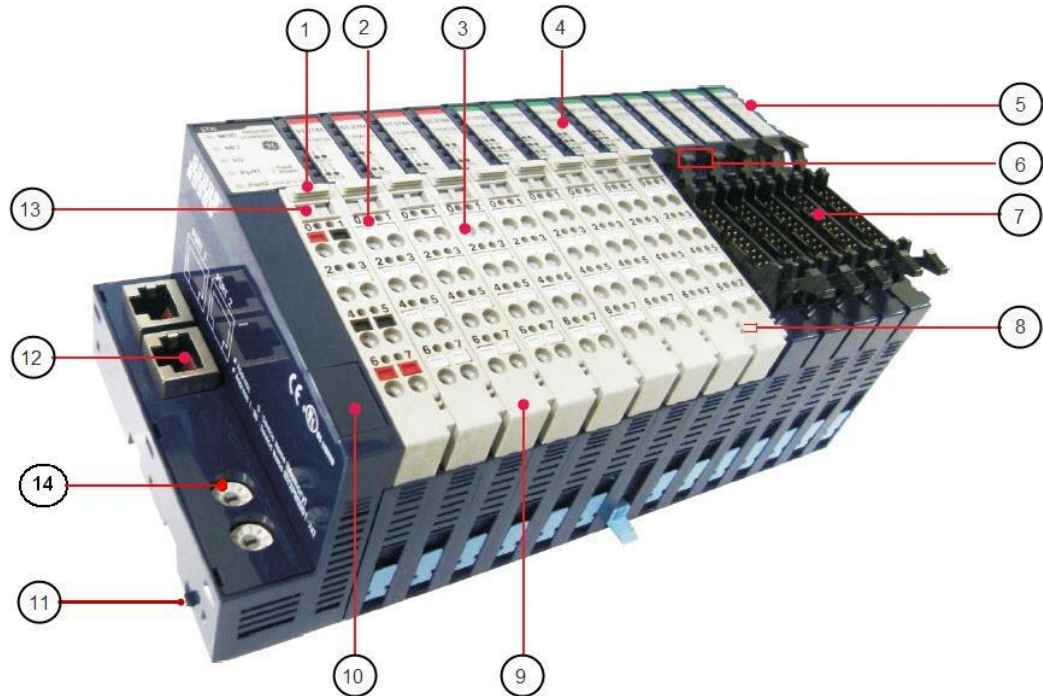
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1. Introduction

The PACSystems RSTi Network Interface and I/O family provides a cost effective, modular distributed I/O system. The RSTi network is ideally suited for distributed applications such as water/wastewater, process control, packaging and assembly. You can easily add RSTi modules to the system to build functional remote I/O stations to meet your application requirements.



Sr. Number	Label
1	Removable Switch of Terminal Block
2	Tester Pin Hole
3	Screw less Connection System
4	I/O Status Display LED
5	System-Data Pin (6 Pins)
6	Module Number Marking (Header Type)
7	Header Type Module (16 points)
8	Field Power Pin (2 pins)

Sr. Number	Label
9	RTB (Removable Terminal Block)
10	Reserved communication Port (Useful to only manufacturer)
11	PUSH Lock for DIN rail
12	Fieldbus Connector (actual connector depends upon the type network adapter)
13	Module Number Marking (on the Removable terminal Block)
14	Node ID or station address setting (either rotary or dip switches depends upon the type of network adapter)

A set of interconnected RSTi modules can be chosen to suit the application and connected as a slave on a MODBUS network. An RSTi Network Adapter provides the interface between the network and the RSTi modules. The Network Adapter and I/O modules selected for an application constitute an I/O station.

1.1 I/O Station Capacity

- Up to 32 IO devices can be connected to a Network Adapter (STXMBS001, STXMBS002, STXMBE001) The power consumption of all the modules in the node should be calculated and ensured that it does not exceed the capacity of Network Adapter and power modules.
- The sum of all input and output data can be up to:
 - 252 bytes per station for a MODBUS network adapter

1.2 Installation

The Network Adapter must be connected to the left of the other RSTi modules in the I/O station.

Within the RSTi station the bus connection, power supply, and power distribution are completed by connecting modules together on the DIN rail. Sensors and actuators are wired to the RSTi modules using spring clamp terminals on the module's removable terminal strips. These terminal strips can be keyed so that they cannot be accidentally swapped. If a module must be replaced, the wiring does not need to be removed; just remove the terminal strip from the module.

1.3 Configuration & Monitoring

The MODBUS Network Adapters can be configured & monitored using IOGuidePro tool, for more information refer the help section of IOGuidePro tool.

1.4 Features

- Modules can be easily installed and connected without tools.
- Flexible and modular structure allows I/O stations to be easily expanded.
- A comprehensive selection of I/O modules supports a wide range of applications.
- Small removable terminal blocks conserve panel space and save time making system connections.
- Module-based diagnostic functions
- The amount of costly parallel wiring is reduced. Within a station, voltage and data routing can be carried out without additional wiring, reducing the cabinet space needed.
- Different parts of the system can be operated independent of one another. This means that pretests can be carried out when the system is set up and that the whole system can be adapted and expanded.

1.5 List of RSTi Network adapters

RSTi MODBUS Network Adapters

- STXMBS001 MODBUS RS-232C network adapter
- STXMBS002 MODBUS RS-485 network adapter
- STXMBE001 MODBUS TCP/IP network adapter

1.6 PACSystems Documentation

- PACSystems RSTi I/O Manual – GFK 2745

2. Installation

Warning

Installing or removing modules or wiring with power applied to the system or field wiring can cause an electrical arc. This can result in unexpected and potentially dangerous action by field devices. Arcing is an explosion risk in hazardous locations. Be sure that the area is non-hazardous or remove power appropriately before installing or removing modules or wiring.

Potentially dangerous voltages are present on a module's terminals, even when system power is turned off. Field power must be turned off when installing or removing a terminal block assembly.

Personnel, who install, operate and maintain automation systems that contain these products must be trained and qualified to perform those functions.

Overloading power modules or Network adapter can result into electric arc and damage to modules.

Caution

Check the rated voltage and terminal array before wiring.

Ensure that specified environmental conditions are not exceeded. Avoid placing the module in direct sunlight.

Review module specifications carefully, and ensure that input and output connections are made in accordance with the specifications.

Use specified cables for wiring.

Field power isolators must be used according to the requirements of the 5VDC/24VDC/48VDC or AC voltage modules used in the system.

If system power consumption exceeds the power limits, use system power expansion modules.

Power supplies for system power and field power must be supplied from separate sources.

2.1 Module Mounting

2.1.1 How to Mount on DIN Rail

1. Press down the module lightly on the DIN Rail until it clicks & locks.

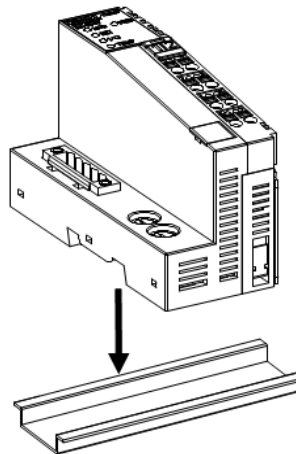


Figure 1: Pressing down the module lightly

2. . You can use the PUSH lock for DIN rail up as a second locking mechanism.

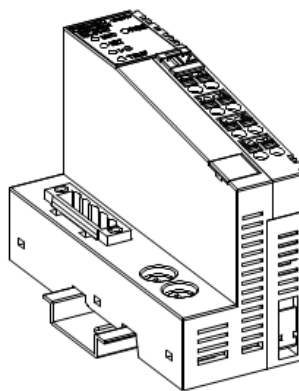


Figure 2: PUSH lock as a second locking mechanism

2.1.2 How to dismount from DIN Rail

1. Pull down the locking mechanism by using small flat screw driver as in the following figures.

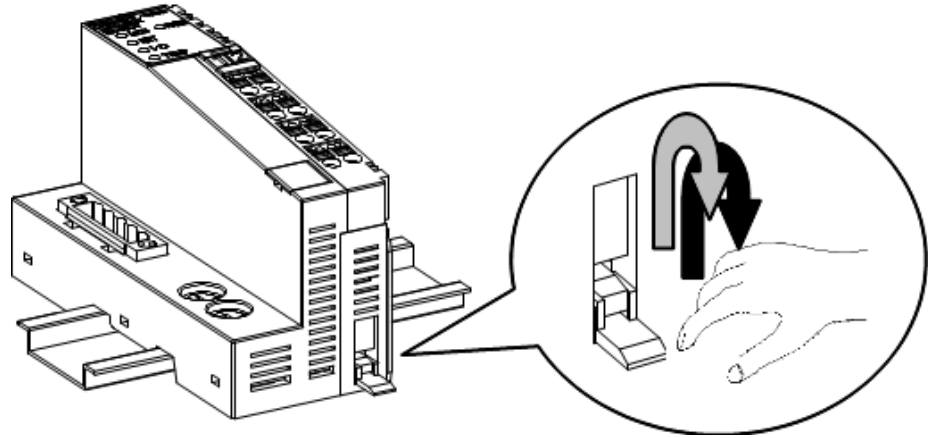


Figure 3: Pulling down the lock

2. Pull up the module to remove from the DIN rail.

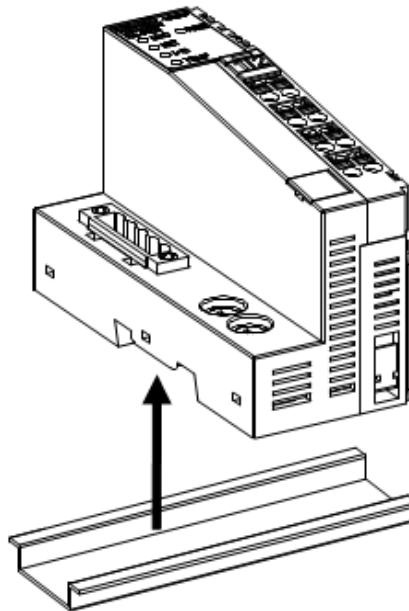


Figure 4: Pulling up the module

2.2 Installing and Removing Components

To plug in the module use a small-bladed screwdriver and push down the locking lever located at bottom of the module. Install the module on DIN rail firmly; push up the locking lever to lock. To pull out the RSTi module, push down the locking lever rail.

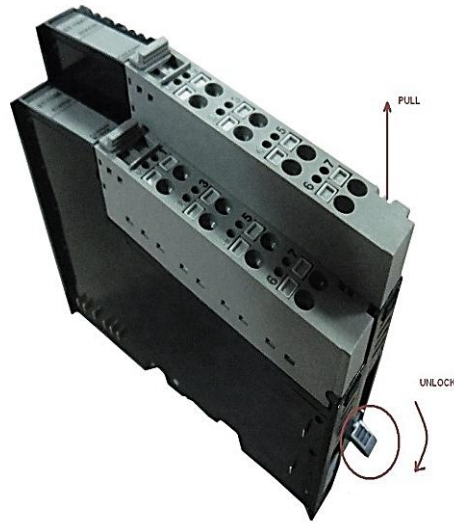


Figure 5: Removing RSTi module from DIN rail

2.3 Internal Bus/Field Power Contacts

Communication between the Network adapters and the IO module as well as system / field power supply of the bus modules is carried out via the internal bus. It is comprised of 6 data pins and 2 field power pins.

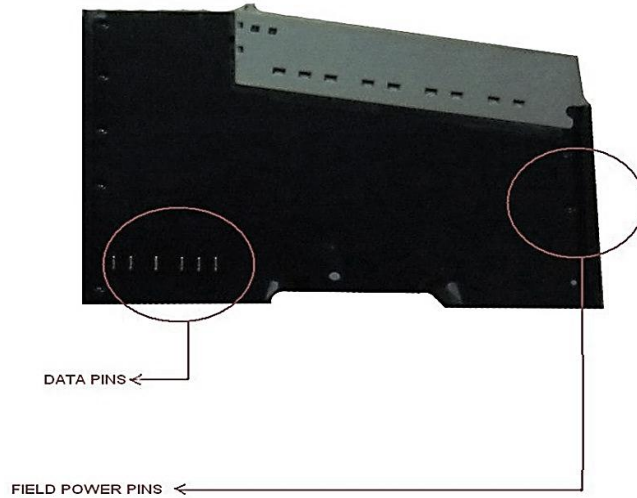


Figure 6: Internal bus with 6 data pins and 2 field power pins

Warning

Do not touch data and field power pins, in order to avoid damage by ESD noise.

2.3.1 RSTi Bus Data Pin & Field Power Pin Description

Table 1: RSTi Bus Pin Name and Description

No.	Name	Description
1	Vcc	System supply voltage (5V dc)
2	GND	System Ground
3	Token Output	Token output port of Processor module
4	Serial Output	Transmitter output port of Processor module
5	Serial Input	Receiver input port of Processor module
6	Reserved	Reserved for bypass Token
7	Field GND	Field Ground
8	Field Vcc	Field supply voltage (24Vdc)

2.3.2 RSTi Data Bus System

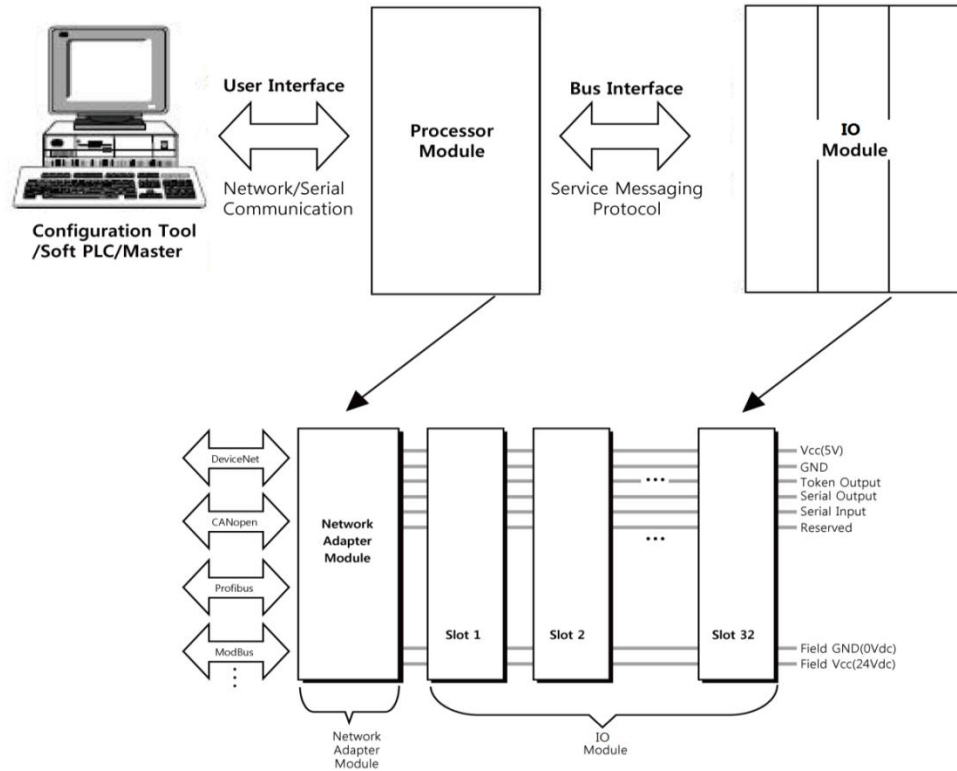


Figure 7: Interface between different modules

- **Network Adapter Module:** The Network Adapter Module forms the link between the field bus and the field devices through IO Modules. The connection to different field bus systems can be established by each of the corresponding Network Adapter Modules: PROFIBUS, CANopen, DeviceNet, Ethernet/IP, CC-Link, MODBUS/Serial, MODBUS/TCP, PROFINET etc.
- **IO Module:** The IO Modules are supported by a variety of input and output field devices. There are digital and analog input/output modules and special function modules.
- **Two types of Bus Message**
 - Service Messaging
 - I/O Messaging

3. MODBUS Serial Network Adapters

3.1 STXMBS001 (MODBUS RS-232C)

3.1.1 Interface

The following figure shows the interface diagram for STXMBS001

MODBUS Electrical Interface

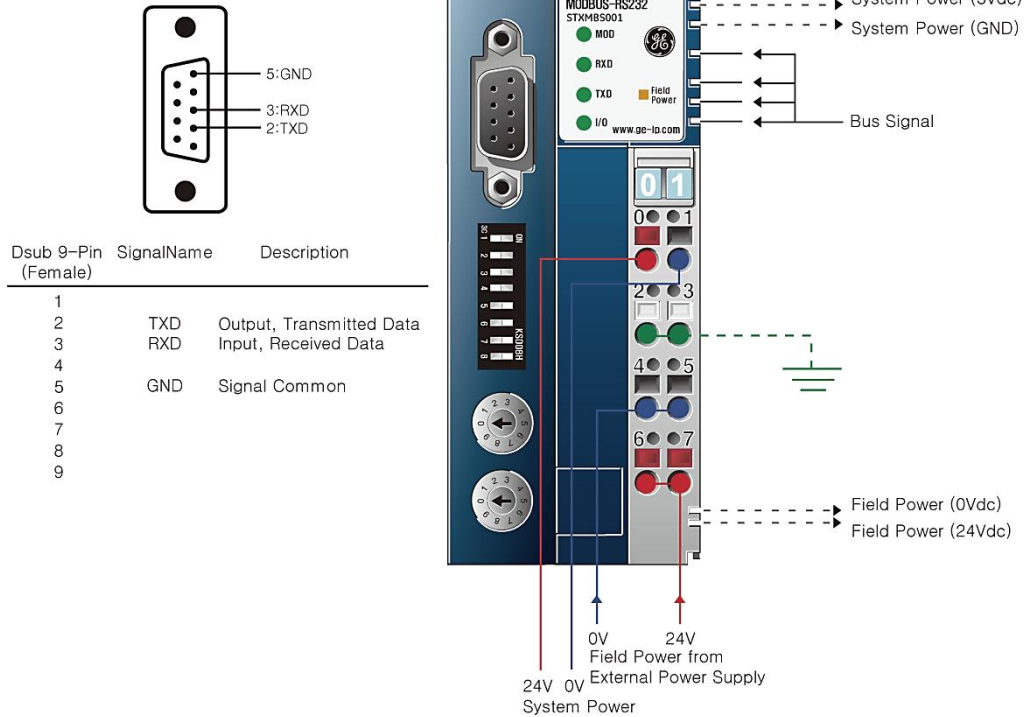


Figure 8: MODBUS Serial Network Adapter Module: STXMBS001

The following table lists the pin numbers and their description for STXMBS001

Table 2: STXMBS001: Pin Description

Pin Number	Description	Pin Number	Description
0	System power 24v	1	System power 0 v
2	Ground	3	Ground
4	Field power 0v	5	Field power 0v
6	Field power 24v	7	Field power 24v

3.2 STXMBS002 (MODBUS RS-485)

3.2.1 Interface

The following figure shows the interface diagram for STXMBS002

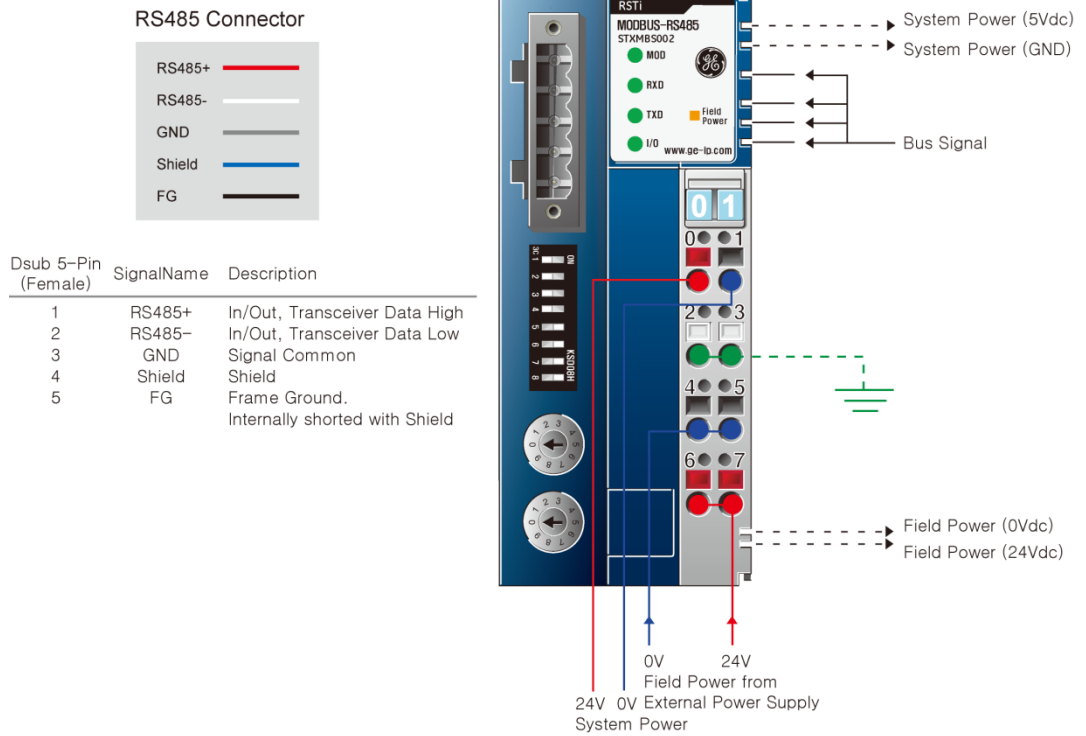


Figure 9: MODBUS serial network adapter module: STXMBS002

The following table lists the pin numbers and their description for STXMBS002

Table 3: STXMBS002: Pin Description

Pin Number	Description	Pin Number	Description
0	System power 24v	1	System power 0 v
2	Ground	3	Ground
4	Field power 0v	5	Field power 0v
6	Field power 24v	7	Field power 24v

3.2.2 Specifications

Table 4: Interface Specifications

Items	Specification
Adapter Type	Slave node (MODBUS Serial RTU/ASCII Server)
Max. IO Module	32 IO Modules
Max. Input Size	126words (252bytes)
Max. Output Size	126words (252bytes)
Max. Length Bus Line	1200m (STXMBS002, RS-485, depends on baud rate), 15m (STXMBS001, RS-232C)
Max. Nodes	64 nodes (STXMBS002, RS-485), 1 node (STXMBS001, RS-232C)
Baud rate	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200bps
Protocol	RTU and ASCII
Interface Connector	5 Pin Open Connector (STXMBS002, RS-485) Dsub 9pin (Female) (STXMBS001, RS-232C)
Settable Node Address	1–99 with two rotary switches
Indicators	5 LEDs 1 Green/Red, Module Status (MOD) 1 Green, Received Data (RXD) 1 Green, Transmit Data (TXD) 1 Green/Red IO Module Status (I/O) 1 Green, Field Power Status
Module Location	First module of RSTi system
Field Power Detection	About 11Vdc

Table 5: General Specifications

Items	Specification
System Power	Supply voltage : 24Vdc nominal Supply voltage range : 11~28.8Vdc Protection : Output current limit (Min. 1.5A) Reverse polarity protection
Power Dissipation	70mA typical @24Vdc
Current for I/O Module	1.5A @5Vdc
Isolation	System power to internal logic: Non-isolation System power to I/O driver: Isolation
Field Power	Supply voltage: 24Vdc nominal Supply voltage range: 11~28.8Vdc
Max. Current Field Power Contact	DC 10A Max.
Weight	150g
Module Size	45mm x 99mm x 70mm
Environment Condition	Refer: Environment Specification

3.2.3 LED Indicators

3.2.3.1 Module Status LED (MOD)

Table 6: Module Status LED

Color	Status	Function
Off	Power off	No power is supplied to the unit.
Solid Green	Device Operational	The unit is operating in normal condition.
Flashing Green	Device in Standby	The device needs commissioning due to configuration missing, incomplete or incorrect.
Green/Red Toggle	MODBUS Error	MODBUS error such as watchdog error, CRC/LRC error, Setup dip switch, error, etc.
Flashing Red	Minor Fault	Recoverable Fault - EEPROM sum check error.
Solid Red	Unrecoverable Fault	The device has an unrecoverable fault. - Memory error or CPU watchdog error.

3.2.3.2 Received Data LED (RXD)

Table 7: Received Data LED

Color	Status	Function
Off	Power off	Device is not on-line or may not be powered
Flashing Green	Adapter received correct message frame	Adapter (Slave) received correct frame which address to the slave or broadcast. About 20msec flashing.

3.2.3.3 Transmit Data LED (TXD)

Table 8: Transmit Data LED

Color	Status	Function
Off	Power off	Device is not on-line or may not be powered
Flashing Green	Adapter transmit frame	Adapter (Slave) transmit frame. About 20msec flashing.

3.2.3.4 IO Module Status LED (I/O)

Table 9: IO Module Status LED

Color	Status	Function
Off	Not powered No IO Module	Device has no IO module or may not be powered
Flashing Green	-Bus On-line, Do not Exchange I/O data	Bus is on-line but does not exchanging I/O data (Passed the IO module configuration).
Solid Green	Bus Connection, Run Exchanging IO data	Exchanging I/O data
Solid Red	Bus connection fault during exchanging IO data	One or more IO module in fault Status. - Changed IO module configuration. - Bus communication failure.
Flashing Red	IO Configuration Failed	Failed to initialize IO module - Detected invalid IO module ID. - Overflowed Input / Output Size - Too many IO module - Initial protocol failure - Mismatch vendor code between adapter and IO module.

3.2.3.5 Field Power Status LED

Table 10: Field Power Status LED

Color	Status	Function
Off	Not Supplied Field Power	Not supplied 24V dc field power
Solid Green	Supplied Field Power	Supplied 24V dc field power

3.2.4 Dimensions

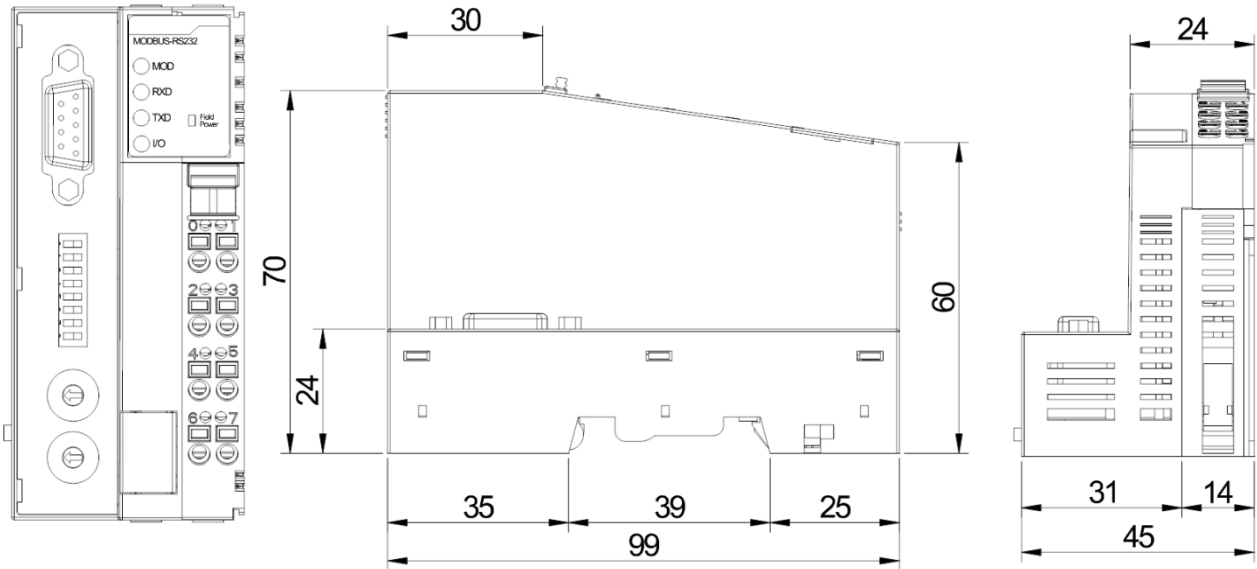


Figure 10: Dimension for STXMBS001/002

3.2.5 Total IO

The maximum number of IO module assemblies that can be connected is 32. So the maximum length is 426mm.

3.3 MODBUS Communication Interface

3.3.1 STXMBS001 (RS-232C)

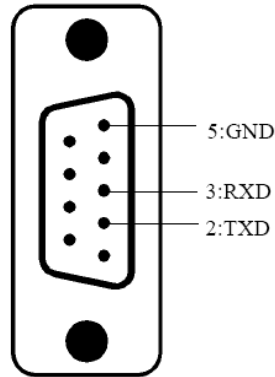


Figure 11: Communication Interface for STXMBS001

The following table describes the Signal Name and Description of STXMBS001

Table 11: Signal name and description

No.	Signal Name	Description
1	-	
2	TXD	Output, Transmitted Data
3	RXD	Input, Received Data
4	-	
5	GND	Signal Common
6	-	
7	-	
8	-	
9	-	

3.3.2 STXMBS002 (RS-485)

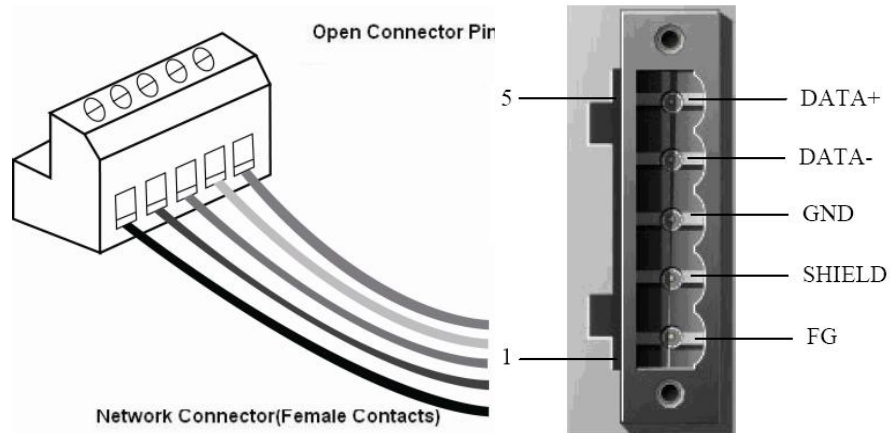


Figure 12: Communication Interface for STXMBS002

The following table describes the Signal Name and Description of STXMBS002

Table 12: Signal name and description

No.	Signal Name	Description
5	DATA +	In/Out, Transceiver Data High
4	DATA -	In/Out, Transceiver Data Low
3	GND	Signal Common
2	SHIELD	Internally Shorted
1	FG	

Warning

The use of an incorrect supply voltage or frequency can cause severe damage to the component.

3.3.2.1 Terminator Resistor

The following diagram displays the terminator resistor specification.

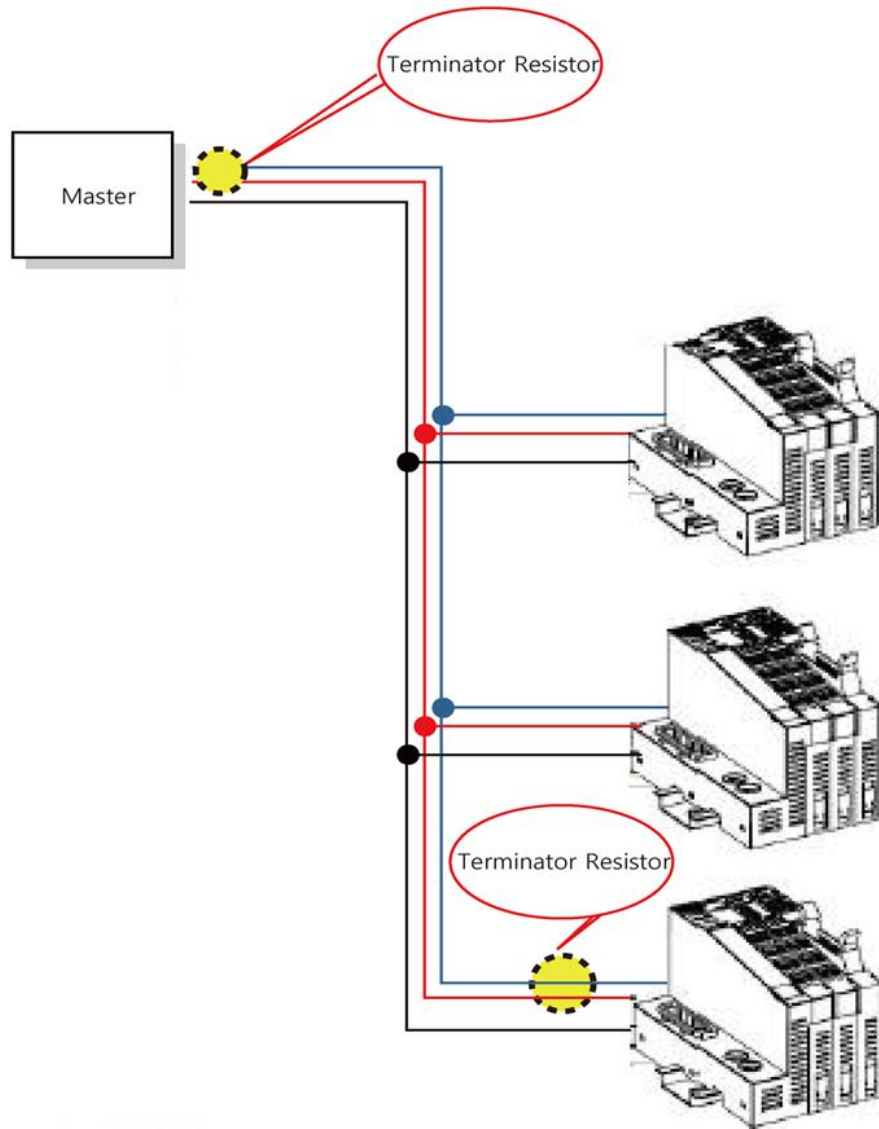
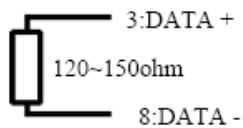


Figure 13: Terminator resistor specification



A reflection in a transmission line is the result of an impedance discontinuity that a traveling wave sees as it propagates down the line. To minimize the reflections from the end of the RS485 cable it is required to place a Line Termination near each of the two ends of the bus.

3.4 MODBUS Module Configuration

3.4.1 DIP Switch Setting

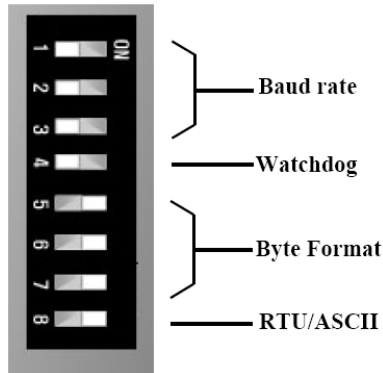


Figure 14: MODBUS DIP Switch Setup

MODBUS Adapter interface configuration can be set by a DIP (8 pole) switch. This setup is read on power-up sequence, i.e. changes to the DIP switch during operation do not affect MODBUS interface configuration.

Table 13: MODBUS adapter Interface configuration set up

Item	Item setup	DIP Switch							
		#1	#2	#3	#4	#5	#6	#7	#8
Baud rate	1200 bps	OFF	OFF	OFF					
	2400 bps	ON	OFF	OFF					
	4800 bps	OFF	ON	OFF					
	9600 bps	ON	ON	OFF					
	19200 bps	OFF	OFF	ON					
	38400 bps	ON	OFF	ON					
	57600 bps	OFF	ON	ON					
	115200 bps	ON	ON	ON					
Watchdog	Disable Watchdog				OFF				
	Enable Watchdog				ON				
Byte Format	8 bit, No Party, 1 Stop					OFF	OFF	OFF	
	8 bit, Even Party, 1 Stop					ON	OFF	OFF	
	8 bit, Odd Party, 1 Stop					OFF	ON	OFF	
	8 bit, No Party, 2 Stop					ON	ON	OFF	
	7 bit, No Party, 2 Stop*					OFF	OFF	ON	
	7 bit, Even Party, 1 Stop*					ON	OFF	ON	
	7 bit, Odd Party, 1 Stop*					OFF	ON	ON	
	7 bit, No Party, 1 Stop*					ON	ON	ON	
RTU/ASCII Mode	RTU Mode								OFF
	ASCII Mode								ON

* Available only in ASCII Mode.

3.4.2 MODBUS Address Setup

Each MODBUS Adapter could have a unique address (from 1 to 99) so that it can be addressed independently from other nodes. The address 0 is reserved to identify a broadcast exchange. No response is returned to broadcast requests sent by the master.

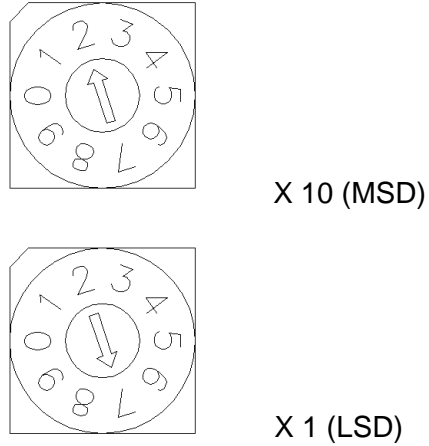


Figure 15: MACID of a slave node

The above figure shows MAC ID 27(=2*10 + 7*1) of a slave node.

Caution

MAC ID addresses have to be unique throughout the entire interconnected networks

3.4.3 I/O Process Image Map

An IO module may have three types of data as I/O data, configuration parameters and memory register. The data exchange between network adapter and IO modules is done via an I/O process image data by Bus protocol. The following figure shows the data flow of process image between network adapter and IO modules.

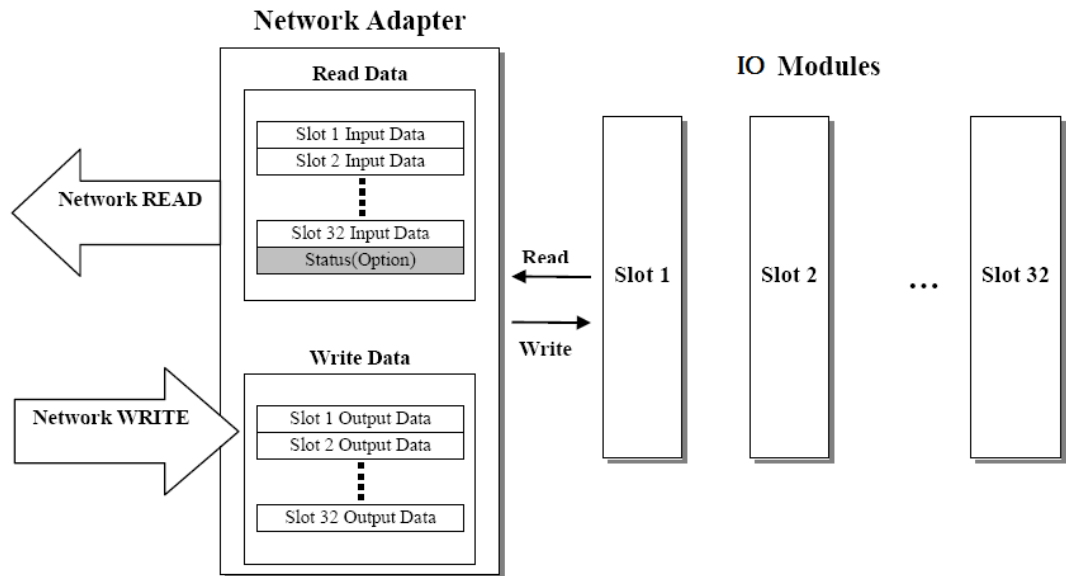


Figure 16: Data exchange between network adapter and IO modules

3.5 MODBUS Interface Register Map / Bit Map

Table 14: Register Map: Read/Write pattern*

Start Address	Read/Write	Description	Function Code
0x0000 ~	Read	Process input image registers (Real Input Register)	4, 23
0x0800 ~	Read/Write	Process output image registers (Real Output Register)	3, 16, 23
0x1000 ~*	Read	Adapter Identification special registers.	3, 4, 23
0x1020 ~*	Read/Write	Adapter Watchdog, other time special register.	3, 4, 6, 16, 23
0x1100 ~*	Read/Write	Adapter Information special registers.	3, 4, 6, 16, 23
0x2000 ~*	Read/Write	IO Module Information special registers.	3, 4, 6, 16, 23

* The special register map must be accessed by read/write of every/each address (one address).

Table 15: Bit Map: Read/Write pattern**

Start Address	Read/Write	Description	Function Code
0x0000 ~	Read	Process input image bits All input registers area is addressable by bit address. Size of input image bit is size of input image register * 16.	2
0x1000 ~	Read/Write	Process output image bits All output registers area is addressable by bit address. Size of output image bit is size of output image register * 16.	1, 5, 15

** Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

3.6 Input Process Image (Input Register) Map

Input image data depends on slot position and IO module data type. Input process image data is only ordered by IO module position when input image mode is uncompressed (mode 0, 2). But, when input image mode is compressed (mode 1, 3), input process image data is ordered by IO slot position and IO module data type.

Input process image mode can be set by special register 0x1114(4372).

Refer: Adapter Information Special Register

- For example: module configuration



Figure 17: Slot configuration

* After the system is reset, the new “Process Image Mode” is set.

The following table lists the slot number and the module description for that slot:

Table 16: Slot number and Module Description

Slot Address	Module Description
#0	MODBUS Adapter
#1	4-discrete input
#2	8-discrete input
#3	2-analog input
#4	16-discrete input
#5	4-discrete input
#6	8-discrete input
#7	4-discrete input
#8	2-analog input
#9	16-discrete input
#10	4-discrete input

3.6.1 Input Process Image Mode#0 (Status 1word) + Uncompressed Input Processing Data

Table 17: Input Process Image Mode#0

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	EW	EC	0	0	0	0	0	0	ES	FP	Bus Status					
0x0001	Discrete In 8pts (Slot#2)								Empty, Always 0			Discrete In 4pts (Slot#1)				
0x0002	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0003	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0004	Discrete In high 8pts (Slot#4)								Discrete In low 8pts (Slot#4)							
0x0005	Discrete In 8pts (Slot#6)								Empty, Always 0			Discrete In 4pts (Slot#5)				
0x0006	Analog Input Ch0 low byte (Slot#8)								Empty, Always 0			Discrete In 4pts (Slot#7)				
0x0007	Analog Input Ch1 low byte (Slot#8)								Analog Input Ch0 high byte (Slot#8)							
0x0008	Discrete In low 8pts (Slot#9)								Analog Input Ch1 high byte (Slot#8)							
0x0009	Empty, Always 0				Discrete In 4pts (Slot#10)				Discrete In high 8pts (Slot#9)							

Status (1word)

✓ **Bus Status :**

- 0: Normal Operation
- 1: Bus Standby
- 2: Bus Communication Fault
- 3: Slot Configuration Failed
- 4: No IO Module

✓ **FP (Field Power) :**

- 0: 24Vdc Field Power On.
- 1: 24Vdc Field Power Off

✓ **ES (MODBUS Error Setup) :**

- 0: No Error Setup
- 1: Error Setup

✓ **EC (MODBUS Error Check) :**

- 0: No Error CRC/LRC
- 1: Error CRC/LRC three times more sequentially since its last restart, clear counters operation, or power-up.

✓ **EW (MODBUS Error Watchdog) :**

- 0: No Error Watchdog
- 1: Error Watchdog once more since its last restart, clear counters operation, or power-up.

3.6.2 Input Process Image Mode#1 (Status(1word) + Compressed Input Processing Data)

Status
(1word)

Table 18: Input Process Image Mode#1

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	EW	EC	0	0	0	0	0	ES	FP	Bus Status						
0x0001	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0002	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0003	Analog Input Ch0 high byte (Slot#8)								Analog Input Ch0 low byte (Slot#8)							
0x0004	Analog Input Ch1 high byte (Slot#8)								Analog Input Ch1 low byte (Slot#8)							
0x0005	Discrete In low 8pts (Slot#4)								Discrete In 8pts (Slot#2)							
0x0006	Discrete In 8pts (Slot#6)								Discrete In high 8pts (Slot#4)							
0x0007	Discrete In high 8pts (Slot#9)								Discrete In low 8pts (Slot#9)							
0x0008	Discrete In 4pts (Slot#10)				Discrete In 4pts (Slot#7)				Discrete In 4pts (Slot#5)				Discrete In 4pts (Slot#1)			

✓ Input Assembly Priority :

- Analog Input Data (Word type)
- 8 or 16 points Discrete Input Data (Byte type)
- 4 points Input Data (Bit type)
- 2 points Input Data (Bit type)

3.6.3 Input Process Image Mode#2 (Uncompressed Input Processing Data without Status), default input image

Table 19: Input Process Image Mode#2

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	Discrete In 8pts (Slot#2)								Empty, Always 0				Discrete In 4pts (Slot#1)			
0x0001	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0002	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0003	Discrete In high 8pts (Slot#4)								Discrete In low 8pts (Slot#4)							
0x0004	Discrete In 8pts (Slot#6)								Empty, Always 0				Discrete In 4pts (Slot#5)			
0x0005	Analog Input Ch0 low byte (Slot#8)								Empty, Always 0				Discrete In 4pts (Slot#7)			
0x0006	Analog Input Ch1 low byte (Slot#8)								Analog Input Ch0 high byte (Slot#8)							
0x0007	Discrete In low 8pts (Slot#9)								Analog Input Ch1 high byte (Slot#8)							
0x0008	Empty, Always 0				Discrete In 4pts (Slot#10)				Discrete In high 8pts (Slot#9)							

3.6.4 Input Process Image Mode#3 (Compressed Input Processing Data without Status)

Table 20: Input Process Image Mode#3

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0001	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0002	Analog Input Ch0 high byte (Slot#8)								Analog Input Ch0 low byte (Slot#8)							
0x0003	Analog Input Ch1 high byte (Slot#8)								Analog Input Ch1 low byte (Slot#8)							
0x0004	Discrete In low 8pts (Slot#4)								Discrete In 8pts (Slot#2)							
0x0005	Discrete In 8pts (Slot#6)								Discrete In high 8pts (Slot#4)							
0x0006	Discrete In high 8pts (Slot#9)								Discrete In low 8pts (Slot#9)							
0x0007	Discrete In 4pts (Slot#10)				Discrete In 4pts (Slot#7)				Discrete In 4pts (Slot#5)				Discrete In 4pts (Slot#1)			

* RSTi Bus uses the byte-oriented register mapping.

* Size of input image bit is size of input image register *16.

✓ **Input Assembly Priority :**

Analog Input Data (Word type)

8 or 16 points Discrete Input Data (Byte type)

4 points Input Data (Bit type)

2 points Input Data (Bit type)

3.7 Output Process Image (Output Register) Map

Output image data depends on slot position and IO Module data type. Output process image data is only ordered by IO slot position when output image mode is uncompressed (mode 0). But, when output image mode is compressed (mode 1), output process image data is ordered by IO slot position and IO module data type.

Output process image mode can be set by special register 0x1115(4373).

Refer: Adapter Information Special Register (0x1100, 4352).

- For example: module configuration



Figure 18: Slot configuration

* After the system is reset, the new “Process Image Mode” is set.

Table 21: Slot number and module description

Slot Address	Module Description
#0	MODBUS Adapter
#1	4-discrete output
#2	8-discrete output
#3	2-analog output
#4	16-discrete output
#5	4-discrete output
#6	8-discrete output
#7	2-relay output
#8	2-relay output
#9	2-analog output
#10	16-discrete output
#11	4-discrete output

3.7.1 Output Process Image Mode#0 (Uncompressed Output Processing Data), default output image

Table 22: Output Process Image Mode#0

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0800	Discrete out 8pts (Slot#2)								Empty, Don't care				Discrete out 4pts (Slot#1)			
0x0801	Analog out Ch0 high byte (Slot#3)								Analog out Ch0 low byte (Slot#3)							
0x0802	Analog out Ch1 high byte (Slot#3)								Analog out Ch1 low byte (Slot#3)							
0x0803	Discrete out high 8pts (Slot#4)								Discrete out low 8pts (Slot#4)							
0x0804	Discrete out 8pts (Slot#6)								Empty, Don't care				Discrete out 4pts (Slot#5)			
0x0805	Empty, Don't care						Discrete out 2pts (Slot#8)		Empty, Don't care						Discrete out 2pts (Slot#7)	
0x0806	Analog out Ch0 high byte (Slot#9)								Analog out Ch0 low byte (Slot#9)							
0x0807	Analog out Ch1 high byte (Slot#9)								Analog out Ch1 low byte (Slot#9)							
0x0808	Discrete out high 8pts (Slot#10)								Discrete out low 8pts (Slot#10)							
0x0809	Empty, Don't care								Empty, Don't care				Discrete out 4pts (Slot#11)			

3.7.2 Output Process Image Mode#1 (Compressed Output Processing Data)

Table 23: Output Process Image Mode#1

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0800	Analog out Ch0 high byte (Slot#3)								Analog out Ch0 low byte (Slot#3)							
0x0801	Analog out Ch1 high byte (Slot#3)								Analog out Ch1 low byte (Slot#3)							
0x0802	Analog out Ch0 high byte (Slot#9)								Analog out Ch0 low byte (Slot#9)							
0x0803	Analog out Ch1 high byte (Slot#9)								Analog out Ch1 low byte (Slot#9)							
0x0804	Discrete out low 8pts (Slot#4)								Discrete out 8pts (Slot#2)							
0x0805	Discrete out 8pts (Slot#6)								Discrete out high 8pts (Slot#4)							
0x0806	Discrete out high 8pts (Slot#10)								Discrete out low 8pts (Slot#10)							
0x0807	Discrete Out 2pts (Slot#8)		Discrete Out 2pts (Slot#7)		Discrete out 4pts (Slot#11)				Discrete out 4pts (Slot#5)				Discrete out 4pts (Slot#1)			

* RSTi Bus uses the byte-oriented register mapping.

* Size of input image bit is size of input image register *16.

- Output Assembly Priority :
 - Analog Output Data (Word type)
 - 8 or 16 points Discrete Output Data (Byte type)
 - 4 points Output Data (Bit type)
 - 2 points Output Data (Bit type)

4. MODBUS TCP/IP Network Adapter

4.1 STXMBE001 (MODBUS TCP/IP)

4.1.1 Interface

The following figure shows the interface diagram for STXMBE001

MODBUS Electrical Interface

RJ-45	Signal Name	Description
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	-
5	-	-
6	RD-	Receive -
7	-	-
8	-	-
Case	Shield	-

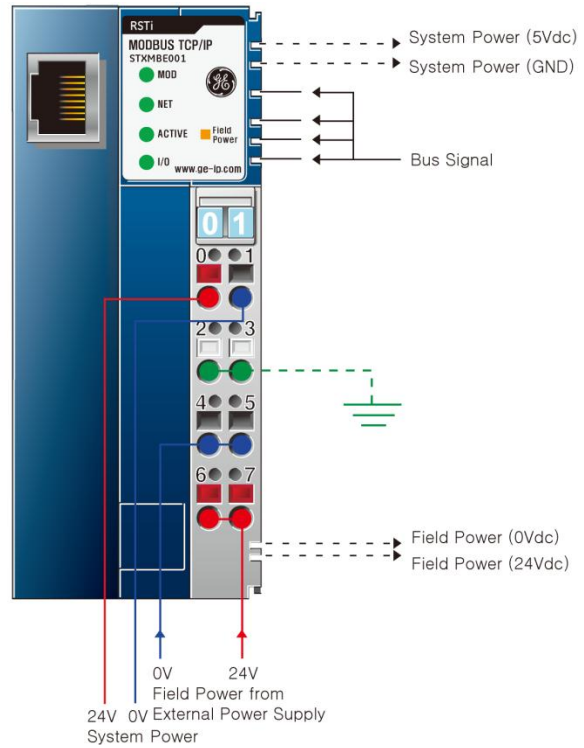


Figure 19: MODBUS serial network adapter module: STXMBE001

The following table lists the pin numbers and their description for STXMBE001

Table 24: STXMBE001: Pin Description

Pin Number	Description	Pin Number	Description
0	System power 24v	1	System power 0 v
2	Ground	3	Ground
4	Field power 0v	5	Field power 0v
6	Field power 24v	7	Field power 24v

4.1.2 Specifications

Table 25: Interface specifications

Items	Specification
Adapter Type	Slave node (MODBUS TCP Server)
Max. IO Module	32 slots
Max. Input Size	126words (252bytes)
Max. Output Size	126words (252bytes)
Max. Length Bus Line	Up to 100m from Ethernet Hub/Switch with twisted CAT 3 UTP/STP
Max. Nodes	Limited by Ethernet Specification
Baud rate	10/100Mbps, Auto-negotiation, Full duplex
Protocol	16 MODBUS/TCP Connections, HTTP, BOOTP
Interface Connector	RJ-45 socket
Settable Node Address	Via ARP, BOOTP
Indicators	5 LEDs 1 Green/Red, Module Status (MOD) 1 Green, Link Status (LINK) 1 Green, Active Status (Active) 1 Green/Red I/O Module Status (I/O) 1 Green, Field Power Status
Module Location	First module of RSTi system
Field Power Detection	About 11Vdc

Table 26: General specifications

Items	Specification
System Power	Supply voltage : 24Vdc nominal Supply voltage range : 11~28.8Vdc Protection : Output current limit (Min. 1.5A) Reverse polarity protection
Power Dissipation	70mA typical @24Vdc
Current for I/O Module	1.5A @5Vdc
Isolation	System power to internal logic: Non-isolation System power to I/O driver: Isolation
Field Power	Supply voltage: 24Vdc nominal Supply voltage range: 11~28.8Vdc
Max. Current Field Power Contact	DC 10A Max.
Weight	150g
Module Size	45mm x 99mm x 70mm
Environment Condition	Refer: Environment Specification

4.1.3 LED Indicators

4.1.3.1 Module Status LED (MOD)

Table 27: Module Status LED

Color	Status	Function
Off	Power off	No power is supplied to the unit.
Solid Green	Device Operational	The unit is operating in normal condition.
Flashing Green	Device in Standby	The device needs commissioning due to configuration missing, incomplete or incorrect.
Green/Red Toggle	MODBUS Error	MODBUS error such as watchdog error, CRC/LRC error, Setup dip switch, error, etc.
Flashing Red	Minor Fault	Recoverable Fault - EEPROM sum check error.
Solid Red	Unrecoverable Fault	The device has an unrecoverable fault. - Memory error or CPU watchdog error.

4.1.3.2 Physical Connection LED (LINK)

Table 28: Received Data LED

Color	Status	Function
Off	Power off	Device is not on-line or may not be powered
Flashing Green	Adapter physical connected	Adapter Ethernet Controller Physically connected

4.1.3.3 Data Exchange LED (ACTIVE)

Table 29: Transmit Data LED

Color	Status	Function
Off	Power off	Device is not on-line or may not be powered
Flashing Green	Adapter exchange data	Adapter (Slave) exchange data/Traffic present. About 10msec flashing.

4.1.3.4 IO Module Status LED (I/O)

Table 30: IO Module Status LED

Color	Status	Function
Off	Not powered No IO Module	Device has no IO module or may not be powered
Flashing Green	-Bus On-line, Do not Exchange I/O data	Bus is on-line but does not exchanging I/O data (Passed the IO module configuration).
Solid Green	Bus Connection, Run Exchanging IO data	Exchanging I/O data
Solid Red	Bus connection fault during exchanging IO data	One or more IO module in fault Status. - Changed IO module configuration. - Bus communication failure.
Flashing Red	IO Configuration Failed	Failed to initialize IO module - Detected invalid IO module ID. - Overflowed Input / Output Size - Too many IO module - Initial protocol failure - Mismatch vendor code between adapter and IO module.

4.1.3.5 Field Power Status LED

Table 31: Field Power Status LED

Color	Status	Function
Off	Not Supplied Field Power	Not supplied 24V dc field power
Solid Green	Supplied Field Power	Supplied 24V dc field power

4.2 MODBUS Module Installation

4.2.1 STXMBE001 Dimensions

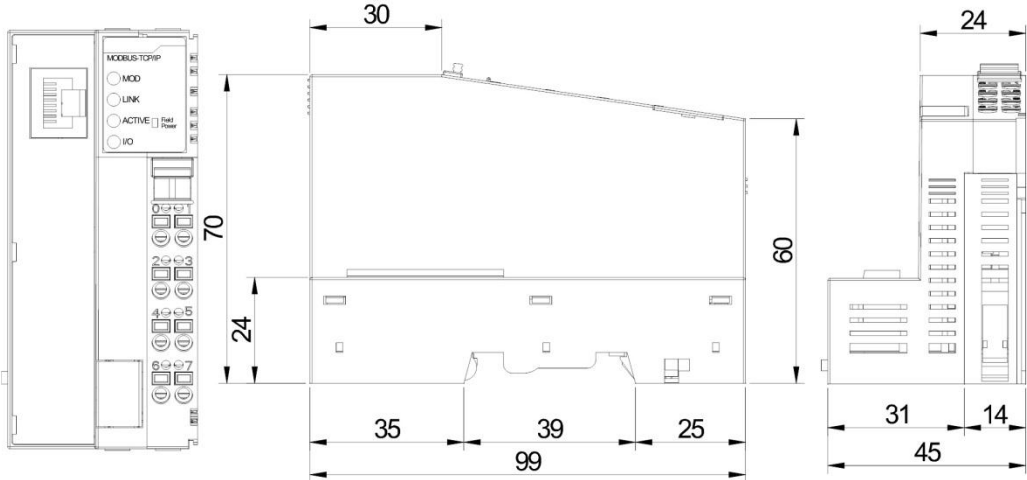


Figure 20: Dimension for STXMBE001

4.2.2 Total IO

The maximum number of IO module assemblies that can be connected is 32. So the maximum length is 426mm.

4.2.3 MODBUS Communication Interface

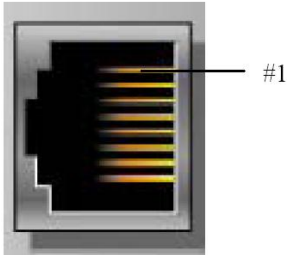


Figure 21: Communication Interface for STXMBE001

The following table describes the Signal Name and Description of STXMBE001

Table 32: Signal name and description

<i>RJ-45</i>	<i>Signal Name</i>	<i>Description</i>
1	TD+	Transmit +
2	TD-	Transmit -
3	RD+	Receive +
4	-	
5	-	
6	RD-	Receive -
7	-	
8	-	
Case	Shield	

Warning

The use of an incorrect supply voltage or frequency can cause severe damage to the component.

4.2.4 MODBUS/TCP IP Address Setup

4.2.4.1 IP-Address Setup using ARP

A way to change the adapter IP address could be applied using such as Command Windows (only applicable same subnet). This new IP address remains during power cycle.

DOS Prompt

```
>ping 192.168.123.236 //current IP address
>arp -a //view Ethernet physical address
>arp -d 192.168.123.236 //delete arp table
>arp -s 192.168.123.237 00-14-F7-00-00-00 //assign static arp table with new IP address
//"00-14-F7-00-00-00" is Ethernet Address
(See Adapter Label)
```

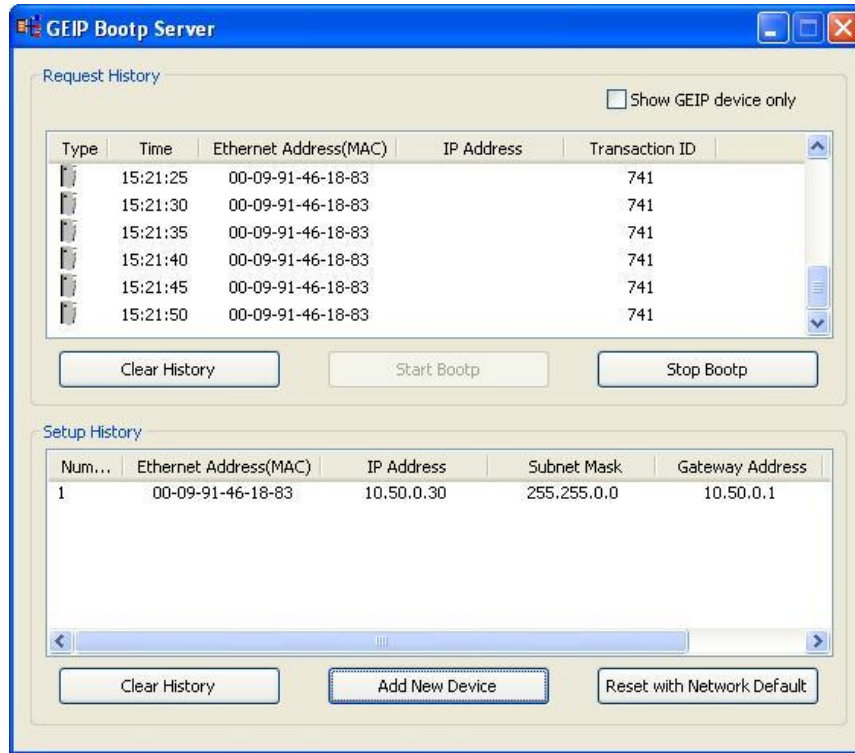
```
>ping -n 1 -I 741 192.168.123.237 //assign new IP address
>arp -d * //clear all arp table
>ping 192.168.123.237 //check response of adapter new IP address
```

After IP-Address setup using ARP.

IP Address = 192.168.123.237
 Subnet Mask = 255.255.255.0
 Gateway = 192.168.123.254

4.2.4.2 IP-Address Setup using BOOTP

If the adapter BOOTP enabled, the adapter sends BOOTP request message of 20 times every 5sec. The following is an example of adapter IP-Address setup that can be used with a BOOTP server. BOOTP tool comes along with IOGuidePro software, for more information refer IOGuidePro help.



To Setup the IP Address

1. Run the GE IP BOOTP Server software
2. Click Start BOOTP in Request History table.
3. Double-click on corresponding MAC ID of the device.
4. In the Setup IP Address dialog box, select the right interface (LAN).
5. Set the IP Address and click OK.
6. In the Setup History table, check the address.
7. Right-click Setup History, and choose Device Information.
8. In the dialog box, verify the parameters, and click Close.

OR

1. Click Add New Device or right-click Setup History Table and choose Add New Device.
2. In the Setup IP Address dialog box, select the suitable interface (LAN)
3. Enter all the address information, and click OK.
4. In the Setup History table, check the address.
5. Right-click Setup History, and choose Device Information.
6. In the dialog box, verify the parameters, and click Close.

4.2.5 Network Adapter Monitoring Using Simple Web Page

RSTi MODBUS TCP Network adapter supports HTTP connections to monitor the Network adapters & IO module data using standard Web browser.

You can use the Web server to monitor the following data:

- Network adapter IP related data, MAC ID, TCP, HTTP connections, firmware revision, Input and output image mode , number of IO modules, Input and out register range.
- IO module input and output data, configuration data.

Note: IO modules are referred as Expansion modules. The web server cannot be used to modify Network adapter or IO module. The data will not be updated until you request another display/refresh.

The maximum number of web server connections that can be configured for the STXMBE001 Ethernet Interface is 4.

Example: <http://192.168.123.1>

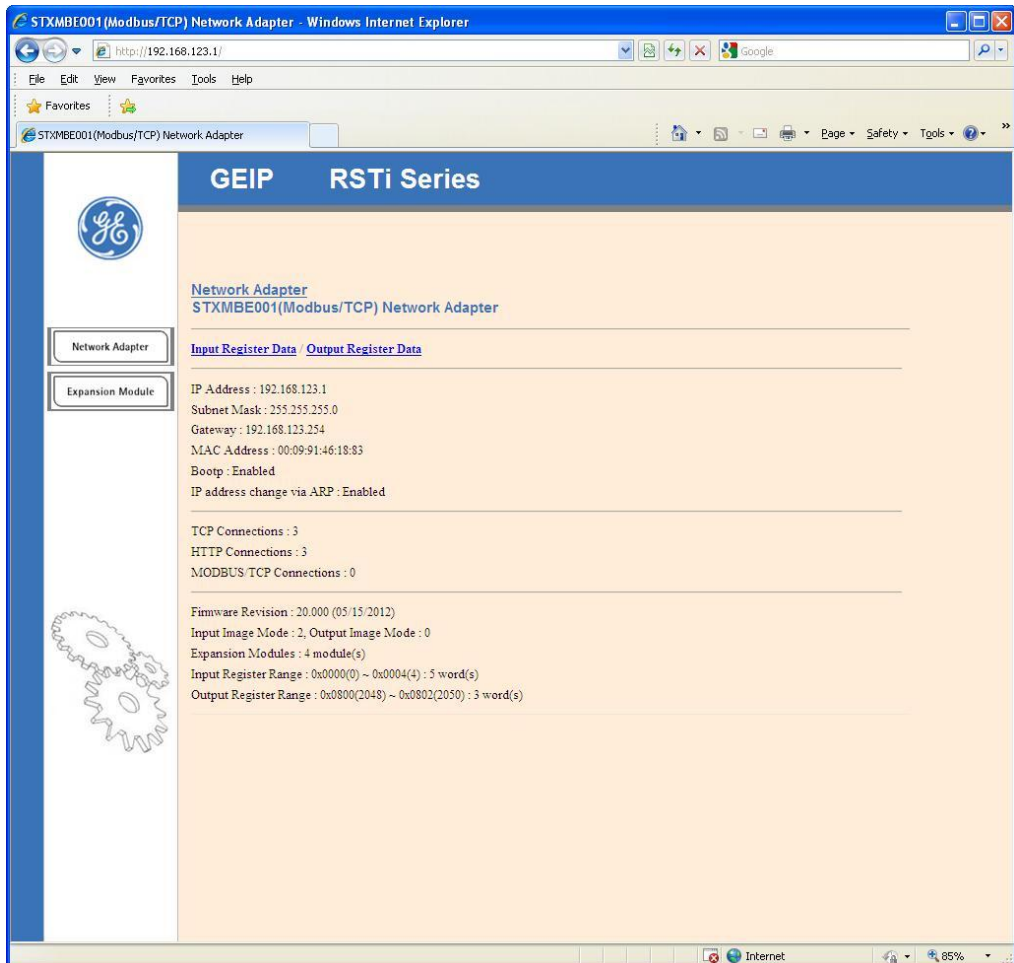


Figure 22:STXMBE001 Network Adapter Web Page View

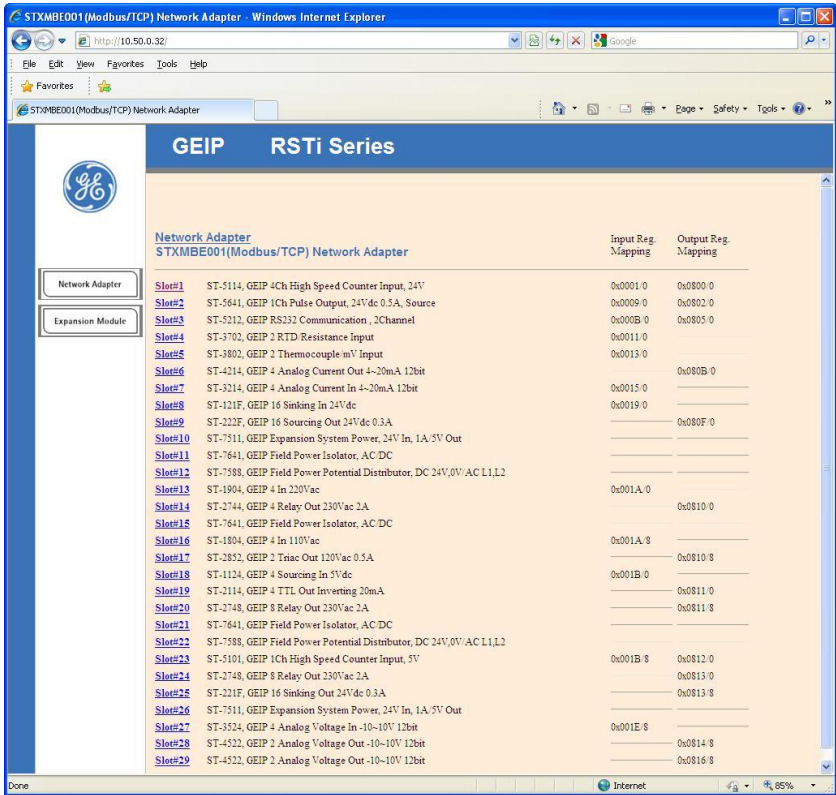


Figure 23: Web page view of IO module connected to STXMBE001

4.2.6 I/O Process Image Map

An IO module may have three types of data as I/O data, configuration parameter and memory register. The data exchange between network adapter and IO modules is done via an I/O process image data by Bus protocol. The following figure shows the data flow of process image between network adapter and IO modules.

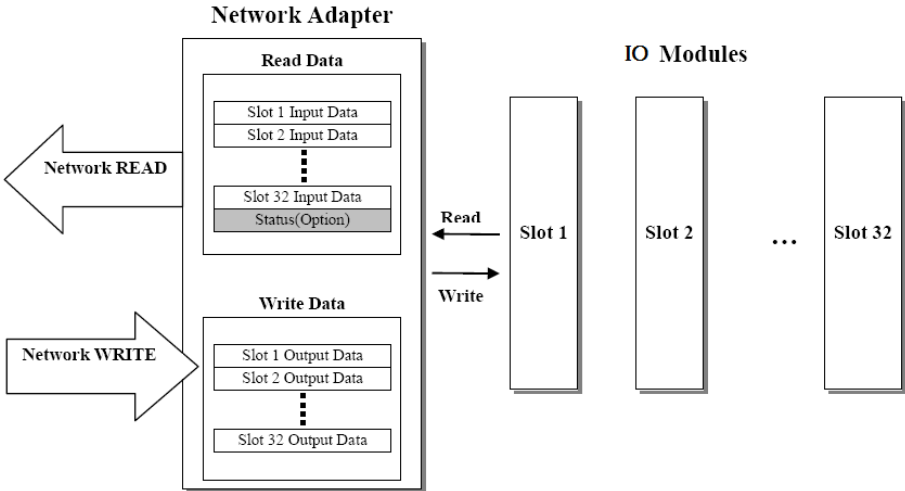


Figure 24: Data exchange between network adapter and IO modules

4.2.7 MODBUS Interface Register Map / Bit Map

Table 33: Register Map: Read/Write Pattern**

Start Address	Read/Write	Description	Function Code
0x0000 ~	Read	Process input image registers (Real Input Register)	4, 23
0x0800 ~	Read/Write	Process output image registers (Real Output Register)	3, 16, 23
0x1000 ~*	Read	Adapter Identification special registers.	3, 4, 23
0x1020 ~*	Read/Write	Adapter Watchdog, other time special register.	3, 4, 6, 16, 23
0x1100 ~*	Read/Write	Adapter Information special registers.	3, 4, 6, 16, 23
0x2000 ~*	Read/Write	IO Module Information special registers.	3, 4, 6, 16, 23

* The special register map must be accessed by read/write of every/each address (one address).

Table 34: Bit Map: Read/Write Pattern**

Start Address	Read/Write	Description	Function Code
0x0000 ~	Read	Process input image bits All input registers area is addressable by bit address. Size of input image bit is size of input image register * 16.	2
0x1000 ~	Read/Write	Process output image bits All output registers area is addressable by bit address. Size of output image bit is size of output image register * 16.	1, 5, 15

** Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

4.3 Input Process Image (Input Register) Map

Input image data depends on slot position and IO module data type. Input process image data is only ordered by IO module position when input image mode is uncompressed (mode 0, 2). But, when input image mode is compressed (mode 1, 3), input process image data is ordered by IO slot position and IO module data type.

Input process image mode can be set by special register 0x1114(4372)*.

Refer: Adapter Information Special Register

- For example: module configuration



Figure 25: Slot configuration

* After the system is reset, the new “Process Image Mode” is applied.

The following table lists the slot number and the module description for that slot:

Table 35: Slot number and Module Description

Slot Address	Module Description
#0	MODBUS Adapter
#1	4-discrete input
#2	8-discrete input
#3	2-analog input
#4	16-discrete input
#5	4-discrete input
#6	8-discrete input
#7	4-discrete input
#8	2-analog input
#9	16-discrete input
#10	4-discrete input

4.3.1 Input Process Image Mode#0 (Status (1word) + Uncompressed Input Processing Data)

Status (1word)

Table 36: Input Process Image Mode#0

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	EW	EC	0	0	0	0	0	0	ES	FP	Bus Status					
0x0001	Discrete In 8pts (Slot#2)								Empty, Always 0			Discrete In 4pts (Slot#1)				
0x0002	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0003	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0004	Discrete In high 8pts (Slot#4)								Discrete In low 8pts (Slot#4)							
0x0005	Discrete In 8pts (Slot#6)								Empty, Always 0			Discrete In 4pts (Slot#5)				
0x0006	Analog Input Ch0 low byte (Slot#8)								Empty, Always 0			Discrete In 4pts (Slot#7)				
0x0007	Analog Input Ch1 low byte (Slot#8)								Analog Input Ch0 high byte (Slot#8)							
0x0008	Discrete In low 8pts (Slot#9)								Analog Input Ch1 high byte (Slot#8)							
0x0009	Empty, Always 0				Discrete In 4pts (Slot#10)				Discrete In high 8pts (Slot#9)							

✓ **Bus Status :**

- 0: Normal Operation
- 1: Bus Standby
- 2: Bus Communication Fault
- 3: Slot Configuration Failed
- 4: No IO Module

✓ **FP (Field Power) :**

- 0: 24Vdc Field Power On.
- 1: 24Vdc Field Power Off

✓ **ES (MODBUS Error Setup) :**

- 0: No Error Setup
- 1: Error Setup

✓ **EC (MODBUS Error Check) :**

- 0: No Error CRC/LRC
- 1: Error CRC/LRC three times more sequentially since its last restart, clear counters operation, or power-up.

✓ **EW (MODBUS Error Watchdog) :**

- 0: No Error Watchdog
- 1: Error Watchdog once more since its last restart, clear counters operation, or power-up.

4.3.2 Input Process Image Mode#1 (Status (1word) + Compressed Input Processing Data)

Table 37: Input Process Image Mode#1

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	EW	EC	0	0	0	0	0	ES	FP	Bus Status						
0x0001	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0002	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0003	Analog Input Ch0 high byte (Slot#8)								Analog Input Ch0 low byte (Slot#8)							
0x0004	Analog Input Ch1 high byte (Slot#8)								Analog Input Ch1 low byte (Slot#8)							
0x0005	Discrete In low 8pts (Slot#4)								Discrete In 8pts (Slot#2)							
0x0006	Discrete In 8pts (Slot#6)								Discrete In high 8pts (Slot#4)							
0x0007	Discrete In high 8pts (Slot#9)								Discrete In low 8pts (Slot#9)							
0x0008	Discrete In 4pts (Slot#10)				Discrete In 4pts (Slot#7)				Discrete In 4pts (Slot#5)				Discrete In 4pts (Slot#1)			

Status (1word)

✓ Input Assembly Priority :

- Analog Input Data (Word type)
- 8 or 16 points Discrete Input Data (Byte type)
- 4 points Input Data (Bit type)
- 2 points Input Data (Bit type)

4.3.3 Input Process Image Mode#2 (Uncompressed Input Processing Data without Status), default input image

Table 38: Input Process Image Mode#2

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	Discrete In 8pts (Slot#2)								Empty, Always 0				Discrete In 4pts (Slot#1)			
0x0001	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0002	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0003	Discrete In high 8pts (Slot#4)								Discrete In low 8pts (Slot#4)							
0x0004	Discrete In 8pts (Slot#6)								Empty, Always 0				Discrete In 4pts (Slot#5)			
0x0005	Analog Input Ch0 low byte (Slot#8)								Empty, Always 0				Discrete In 4pts (Slot#7)			
0x0006	Analog Input Ch1 low byte (Slot#8)								Analog Input Ch0 high byte (Slot#8)							
0x0007	Discrete In low 8pts (Slot#9)								Analog Input Ch1 high byte (Slot#8)							
0x0008	Empty, Always 0				Discrete In 4pts (Slot#10)				Discrete In high 8pts (Slot#9)							

4.3.4 Input Process Image Mode#3 (Compressed Input Processing Data without Status)

Table 39: Input Process Image Mode#3

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0000	Analog Input Ch0 high byte (Slot#3)								Analog Input Ch0 low byte (Slot#3)							
0x0001	Analog Input Ch1 high byte (Slot#3)								Analog Input Ch1 low byte (Slot#3)							
0x0002	Analog Input Ch0 high byte (Slot#8)								Analog Input Ch0 low byte (Slot#8)							
0x0003	Analog Input Ch1 high byte (Slot#8)								Analog Input Ch1 low byte (Slot#8)							
0x0004	Discrete In low 8pts (Slot#4)								Discrete In 8pts (Slot#2)							
0x0005	Discrete In 8pts (Slot#6)								Discrete In high 8pts (Slot#4)							
0x0006	Discrete In high 8pts (Slot#9)								Discrete In low 8pts (Slot#9)							
0x0007	Discrete In 4pts (Slot#10)				Discrete In 4pts (Slot#7)				Discrete In 4pts (Slot#5)				Discrete In 4pts (Slot#1)			

* RStiBus uses the byte-oriented register mapping.

* Size of input image bit is size of input image register *16.

✓ **Input Assembly Priority :**

Analog Input Data (Word type)

8 or 16 points Discrete Input Data (Byte type)

4 points Input Data (Bit type)

2 points Input Data (Bit type)

4.4 Output Process Image (Output Register) Map

Output image data depends on slot position and IO Module data type. Output process image data is only ordered by IO slot position when output image mode is uncompressed (mode 0). But, when output image mode is compressed (mode 1), output process image data is ordered by IO slot position and IO module data type.

Output process image mode can be set by special register 0x1115(4373).

Refer: Adapter Information Special Register (0x1100, 4352)*.

- For example: module configuration



Figure 26: Slot configuration

* After the system is reset, the new “Process Image Mode” is set.

Table 40: Slot number and module description

Slot Address	Module Description
#0	MODBUS Adapter
#1	4-discrete output
#2	8-discrete output
#3	2-analog output
#4	16-discrete output
#5	4-discrete output
#6	8-discrete output
#7	2-relay output
#8	2-relay output
#9	2-analog output
#10	16-discrete output
#11	4-discrete output

4.4.1 Output Process Image Mode#0 (Uncompressed Output Processing Data), default output image

Table 41: Output Process Image Mode#0

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0800	Discrete out 8pts (Slot#2)								Empty, Don't care				Discrete out 4pts (Slot#1)			
0x0801	Analog out Ch0 high byte (Slot#3)								Analog out Ch0 low byte (Slot#3)							
0x0802	Analog out Ch1 high byte (Slot#3)								Analog out Ch1 low byte (Slot#3)							
0x0803	Discrete out high 8pts (Slot#4)								Discrete out low 8pts (Slot#4)							
0x0804	Discrete out 8pts (Slot#6)								Empty, Don't care				Discrete out 4pts (Slot#5)			
0x0805	Empty, Don't care							Discrete out 2pts (Slot#8)	Empty, Don't care						Discrete out 2pts (Slot#7)	
0x0806	Analog out Ch0 high byte (Slot#9)								Analog out Ch0 low byte (Slot#9)							
0x0807	Analog out Ch1 high byte (Slot#9)								Analog out Ch1 low byte (Slot#9)							
0x0808	Discrete out high 8pts (Slot#10)								Discrete out low 8pts (Slot#10)							
0x0809	Empty, Don't care								Empty, Don't care				Discrete out 4pts (Slot#11)			

4.4.2 Output Process Image Mode#1 (Compressed Output Processing Data)

Table 42: Output Process Image Mode#1

Addr.	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0
0x0800	Analog out Ch0 high byte (Slot#3)								Analog out Ch0 low byte (Slot#3)							
0x0801	Analog out Ch1 high byte (Slot#3)								Analog out Ch1 low byte (Slot#3)							
0x0802	Analog out Ch0 high byte (Slot#9)								Analog out Ch0 low byte (Slot#9)							
0x0803	Analog out Ch1 high byte (Slot#9)								Analog out Ch1 low byte (Slot#9)							
0x0804	Discrete out low 8pts (Slot#4)								Discrete out 8pts (Slot#2)							
0x0805	Discrete out 8pts (Slot#6)								Discrete out high 8pts (Slot#4)							
0x0806	Discrete out high 8pts (Slot#10)								Discrete out low 8pts (Slot#10)							
0x0807	Discrete Out 2pts (Slot#8)		Discrete Out 2pts (Slot#7)		Discrete out 4pts (Slot#11)			Discrete out 4pts (Slot#5)				Discrete out 4pts (Slot#1)				

* RSTiBus uses the byte-oriented register mapping.

* Size of input image bit is size of input image register *16.

✓ **Output Assembly Priority :**

Analog Output Data (Word type)

8 or 16 points Discrete Output Data (Byte type)

4 points Output Data (Bit type)

2 points Output Data (Bit type)

5. MODBUS Interface

5.1 Supported MODBUS Function Codes

Table 43: Functions and Descriptions

Function Code	Function	Description	Unicast / Broadcast
1 (0x01)	Read Coils	Read output bit	Unicast
2 (0x02)	Read Discrete Inputs	Read input bit	Unicast
3 (0x03)	Read Holding Registers	Read output word	Unicast
4 (0x04)	Read Input Registers	Read input word	Unicast
5 (0x05)	Write Single Coil	Write one bit output	Unicast / Broadcast
6 (0x06)	Write Single Register	Write one word output	Unicast / Broadcast
8 (0x08)	Diagnostics (Serial Line only)	Read diagnostic register	Unicast
15 (0x0F)	Write Multiple Coils	Write a number of output bits	Unicast / Broadcast
16 (0x10)	Write Multiple registers	Write a number of output words	Unicast / Broadcast
23 (0x17)	Read / Write Multiple register	Read a number of input words / Write a number of output words	Unicast

5.1.1 1 (0x01) Read Coils

This function code is used to read from 1 to 2000 contiguous status of coils in a remote device. The Request PDU specifies the starting address, i.e. the address of the first coil specified, and the number of coils. In the PDU Coils are addressed starting at zero. Therefore coils numbered 1-16 are addressed as 0-15.

The coils in the response message are packed as one coil per bit of the data field. Status is indicated as 1= ON and 0= OFF.

Table 44: Read Coils Request description

Field name	Example	RTU	ASCII	ASCII (bus line)
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x01	0x01	“01”	0x30, 0x31
Starting Address Hi	0x10	0x10	“10”	0x31, 0x30
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Lo	0x0A	0x0A	“0A”	0x30, 0x41
Error Check (CRC/LRC)	-	0xB8, 0xAB	“DE”	0x44, 0x45
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 45: Read Coils Response description

Field name	Example	RTU	ASCII	ASCII (bus line)
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x01	0x01	“01”	0x30, 0x31
Byte Count	0x02	0x02	“02”	0x30, 0x32
Output Status	0x55	0x55	“55”	0x35, 0x35
Output Status	0x02	0x02	“02”	0x30, 0x32
Error Check (CRC/LRC)	-	0x8F, 0x6D	“9F”	0x39, 0x46
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

* In case of address 0x1015~0x1000 output bit value: 00000010_01010101.

5.1.2 2 (0x02) Read Discrete Inputs

This function code is used to read from 1 to 2000 contiguous status of discrete inputs in a remote device. The Request PDU specifies the starting address, i.e. the address of the first input specified, and the number of inputs. In the PDU Discrete Inputs are addressed starting at zero. Therefore Discrete inputs numbered 1-16 are addressed as 0-15. The discrete inputs in the response message are packed as one input per bit of the data field.

Status is indicated as 1= ON; 0= OFF.

Table 46: Read Discrete Input request description

Field name	Example	RTU	ASCII	ASCII (bus line)
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x02	0x02	“02”	0x30, 0x32
Starting Address Hi	0x00	0x00	“00”	0x30, 0x30
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Inputs Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Inputs Lo	0x0A	0x0A	“0A”	0x30, 0x41
Error Check (CRC/LRC)	-	0xF8, 0x6B	“ED”	0x45, 0x44
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 47: Read Discrete Input Response description

Field name	Example	RTU	ASCII	ASCII (bus line)
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x02	0x02	“02”	0x30, 0x32
Byte Count	0x02	0x02	“02”	0x30, 0x32
Input Status	0x80	0x80	“80”	0x38, 0x30
Input Status	0x00	0x00	“00”	0x30, 0x30
Error Check (CRC/LRC)	-	0x50, 0x78	“75”	0x37, 0x35
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

In case of address 0x0015~0x0000 output bit value: 00000000_10000000.

5.1.3 3 (0x03) Read Holding Registers

This function code is used to read the contents of a contiguous block of holding registers in a remote device. The Request PDU specifies the starting register address and the number of registers.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Table 48: Read Holding Registers Request Description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x03	0x03	“03”	0x30, 0x33
Starting Address Hi	0x08	0x08	“08”	0x30, 0x38
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Register Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Register Lo	0x02	0x02	“02”	0x30, 0x32
Error Check (CRC/LRC)	-	0xC6, 0x0D	“EC”	0x45, 0x43
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 49: Read Holding Registers Response Description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x03	0x03	“03”	0x30, 0x33
Byte Count	0x04	0x04	“04”	0x30, 0x34
Output Register #0 Hi	0x11	0x11	“11”	0x31, 0x31
Output Register #0 Lo	0x22	0x22	“22”	0x32, 0x32
Output Register #1 Hi	0x33	0x33	“33”	0x33, 0x33
Output Register #1 Lo	0x44	0x44	“44”	0x34, 0x34
Error Check (CRC/LRC)	-	0x2D, 0xC6	“38”	0x33, 0x38
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

In case of address 0x0800, 0x0801 output register value: 0x1122, 0x3344.

5.1.4 4 (0x04) Read Input Registers

This function code is used to read from 1 to approx. 125 contiguous input registers in a remote device. The Request PDU specifies the starting register address and the number of registers.

The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

Table 50: Read Input Registers Request description

Field name	Example	RTU	ASCII	ASCII (bus line)
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x04	0x04	“04”	0x30, 0x34
Starting Address Hi	0x00	0x00	“00”	0x30, 0x30
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Register Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Register Lo	0x02	0x02	“02”	0x30, 0x32
Error Check (CRC/LRC)	-	0x71, 0xAD	“F3”	0x46, 0x33
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 51: Read Input Registers Response description

Field name	Example	RTU	ASCII	ASCII (bus line)
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x04	0x04	“04”	0x30, 0x34
Byte Count	0x04	0x04	“04”	0x30, 0x34
Input Register #0 Hi	0x00	0x00	“00”	0x30, 0x30
Input Register #0 Lo	0x80	0x80	“80”	0x38, 0x30
Input Register #1 Hi	0x00	0x00	“00”	0x30, 0x30
Input Register #1 Lo	0x00	0x00	“00”	0x30, 0x30
Error Check (CRC/LRC)	-	0x9C, 0x6C	“71”	0x37, 0x31
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

In case of address 0x0000, 0x0001 input register value: 0x0080, 0x0000.

5.1.5 5 (0x05) Write Single Coil

This function code is used to write a single output to either ON or OFF in a remote device. The requested ON/OFF Status is specified by a constant in the request data field. A value of FF 00 hex requests the output to be ON. A value of 00 00 requests it to be OFF. All other values are illegal and will not affect the output.

Table 52: Write Single Coil Request description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x05	0x05	“05”	0x30, 0x35
Starting Address Hi	0x10	0x10	“10”	0x31, 0x30
Starting Address Lo	0x01	0x01	“01”	0x30, 0x31
Quantity of Outputs Hi	0xFF	0xFF	“FF”	0x46, 0x46
Quantity of Outputs Lo	0x00	0x00	“00”	0x30, 0x30
Error Check (CRC/LRC)	-	0xD9, 0x5C	“E4”	0x45, 0x34
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 53: Write Single Coil Response description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x05	0x05	“05”	0x30, 0x35
Output Address Hi	0x10	0x10	“10”	0x31, 0x30
Output Address Lo	0x01	0x01	“01”	0x30, 0x31
Output Value Hi	0xFF	0xFF	“FF”	0x46, 0x46
Output Value Lo	0x00	0x00	“00”	0x30, 0x30
Error Check (CRC/LRC)	-	0xD9, 0x5C	“E4”	0x45, 0x34
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Output bit of address 0x1001 turns ON.

5.1.6 6 (0x06) Write Single Register

This function code is used to write a single holding register in a remote device. Therefore register numbered 1 is addressed as 0. The normal response is an echo of the request, returned after the register contents have been written.

Table 54: Write Single Register Request description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x06	0x06	“06”	0x30, 0x36
Starting Address Hi	0x08	0x08	“08”	0x30, 0x38
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Hi	0x11	0x11	“11”	0x31, 0x31
Quantity of Outputs Lo	0x22	0x22	“22”	0x32, 0x32
Error Check (CRC/LRC)	-	0x07, 0x85	“B8”	0x42, 0x38
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 55: Write Single Coil Response description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x06	0x06	“06”	0x30, 0x36
Output Address Hi	0x08	0x08	“08”	0x31, 0x38
Output Address Lo	0x00	0x00	“00”	0x30, 0x30
Output Value Hi	0x11	0x11	“11”	0x31, 0x31
Output Value Lo	0x22	0x22	“22”	0x32, 0x32
Error Check (CRC/LRC)	-	0x07, 0x85	“B8”	0x42, 0x38
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

In case of address 0x0800 outputs register value: 0x0000 changes to 0x1122.

5.1.7 8 (0x08) Diagnostics

MODBUS function code 08 provides a series of tests for checking the communication system between a client (Master) device and a server (Slave), or for checking various internal error conditions within a server.

The function uses a two-byte sub-function code field in the query to define the type of test to be performed. The server echoes both the function code and sub-function code in a normal response. Some of the diagnostics cause data to be returned from the remote device in the data field of a normal response.

Table 56: Diagnostics Request Description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x08	0x08	“08”	0x30, 0x38
Sub-Function Hi	0x00	0x00	“00”	0x30, 0x30
Sub-Function Lo	0x00	0x00	“00”	0x30, 0x30
Data Hi	0x11	0x11	“11”	0x31, 0x31
Data Lo	0x22	0x22	“22”	0x32, 0x32
Error Check (CRC/LRC)	-	0x6C, 0x24	“BE”	0x42, 0x45
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 57: Diagnostics Response Description

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x08	0x08	“08”	0x30, 0x38
Sub-Function Hi	0x00	0x00	“00”	0x30, 0x30
Sub-Function Lo	0x00	0x00	“00”	0x30, 0x30
Data Hi	0x11	0x11	“11”	0x31, 0x31
Data Lo	0x22	0x22	“22”	0x32, 0x32
Error Check (CRC/LRC)	-	0x6C, 0x24	“BE”	0x42, 0x45
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

5.1.7.1 Diagnostics Sub functions

Sub-function 0x0000(0) Return Query Data

The data passed in the request data field is to be returned (looped back) in the response. The entire response message should be identical to the request.

Table 58: Return query data

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x0000(0)	Any	Echo Request Data	

Sub-function 0x0001(1) Restart Communications Option

The remote device could be initialized and restarted, and all of its communications event counters are cleared.

Table 59: Restart communications

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x0001(1)	0x0000, 0xFF00	Echo Request Data	Reset

Sub-function 0x000A(10) Clear Counters and Diagnostic Register

The goal is to clear all counters and the diagnostic register. Counters are also cleared upon power-up.

Table 60: Clear counters and Diagnostic register

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000A(10)	0x0000	Echo Request Data	

Sub-function 0x000B(11) Return Bus Message Count

The response data field returns the quantity of messages that the remote device has detected on the communications system since its last restart, clear counters operation, or power-up.

Table 61: Return Bus Message count

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000B(11)	0x0000	Total Message Count	

Sub-function 0x000C(12) Return Bus Communication Error Count

The response data field returns the quantity of CRC errors encountered by the remote device since its last restart, clear counters operation, or power-up.

Table 62: Return Bus Communication Error Count

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000C(12)	0x0000	CRC Error Count	

Sub-function 0x000D(13) Return Bus Exception Error Count

The response data field returns the quantity of MODBUS exception responses returned by the remote device since its last restart, clear counters operation, or power-up.

Exception responses are described and listed in section: Error response.

Table 63: Return Bus Exception Error Count

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000D(13)	0x0000	Exception Error Count	

Sub-function 0x000E(14) Return Slave Message Count

The response data field returns the quantity of messages addressed to the remote device, or broadcast, that the remote device has processed since its last restart, clear counters operation, or power-up.

Table 64: Return Slave Message Count

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000E(14)	0x0000	Slave Message Count	

Sub-function 0x000F(15) Return Slave No Response Count

The response data field returns the quantity of messages addressed to the remote device for which it has returned no response (neither a normal response nor an exception response), since its last restart, clear counters operation, or power-up.

Table 65: Return Slave No Response Count

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x000F(15)	0x0000	Slave No Response Count	

Sub-function 0x0064(100) Return Slave MODBUS, Bus Status

The response data field returns the status of MODBUS and Bus addressed to the remote device.

This status values are identical with status 1word of input process image. Refer: Example of Input Process Image.

Table 66: Return Slave MODBUS, Bus Status

Sub-function	Data Field (Request)	Data Field (Response)	Description
0x0064(100)	0x0000	MODBUS, Bus Status	Same as status 1word

Sub-function 0x0065(101) Return Slave MODBUS, Error Count

The response data field returns the quantity of watchdog error addressed to the remote device since its last restart, clear counters operation, or power-up.

Table 67: Return Slave MODBUS, Error Count

<i>Sub-function</i>	<i>Data Field (Request)</i>	<i>Data Field (Response)</i>	<i>Description</i>
0x0065(101)	0x0000	Watchdog Error Count	

Sub-function 0x0066(102) Change Slave IO Output Status

The sub-function with data fields is to clear watchdog counter and change IO output status. This may be used to simulate clear output and fault output.

Table 68: Change Slave IO Output Status

<i>Sub-function</i>	<i>Data Field (Request)</i>	<i>Data Field (Response)</i>	<i>Description</i>
0x0066(102)	0x0000	Echo Request Data	Ready output, Automatically turns Normal output
0x0066(102)	0x0001, 0x0002, 0x0003	Echo Request Data	Clear output
0x0066(102)	0x0004	Echo Request Data	Normal output
0x0066(102)	0x0005, 0x0006, 0x0007	Echo Request Data	Fault output

5.1.8 15 (0x0F) Write Multiple Coils

This function code is used to force each coil in a sequence of coils to either ON or OFF in a remote device. The Request PDU specifies the coil references to be forced. Coils are addressed starting at zero. A logical '1' in a bit position of the field requests the corresponding output to be ON. A logical '0' requests it to be OFF.

The normal response returns the function code, starting address, and quantity of coils forced.

Table 69: Write Multiple Coils Request

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x0F	0x0F	“0F”	0x30, 0x46
Starting Address Hi	0x10	0x10	“10”	0x31, 0x30
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Lo	0x0A	0x0A	“0A”	0x30, 0x41
Byte Count	0x02	0x02	“02”	0x30, 0x32
Output Value #0	0x55	0x55	“55”	0x35, 0x35
Output Value #1	0x01	0x01	“01”	0x30, 0x31
Error Check (CRC/LRC)	-	0x21, 0XC9	“78”	0x37, 0x38
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 70: Write Multiple Coils Response

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x0F	0x0F	“0F”	0x30, 0x46
Starting Address Hi	0x10	0x10	“10”	0x31, 0x30
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Lo	0x0A	0x0A	“0A”	0x30, 0x41
Error Check (CRC/LRC)	-	0xD1, 0x6A	“D0”	0x44, 0x30
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

In case of address 0x1015~0x1000 output bit value: 00000000_00000000 changes to 00000001_01010101.

5.1.9 16 (0x10) Write Multiple Registers

This function code is used to write a block of contiguous registers (1 to approx. 120 registers) in a remote device.

The requested written values are specified in the request data field. Data is packed as two bytes per register.

The normal response returns the function code, starting address, and quantity of registers written.

Table 71: Write Multiple Registers Request

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x0F	0x0F	“0F”	0x30, 0x46
Starting Address Hi	0x08	0x08	“08”	0x30, 0x38
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Registers Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Registers Lo	0x02	0x02	“02”	0x30, 0x32
Byte Count	0x04	0x04	“04”	0x30, 0x34
Register Value #0 Hi	0x11	0x11	“11”	0x31, 0x31
Register Value #0 Lo	0x22	0x22	“22”	0x32, 0x32
Register Value #1 Hi	0x33	0x33	“33”	0x33, 0x33
Register Value #1 Lo	0x44	0x44	“44”	0x34, 0x34
Error Check (CRC/LRC)	-	0x3B, 0x12	“31”	0x33, 0x31
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 72: Write Multiple Registers Response

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“,”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x0F	0x0F	“0F”	0x30, 0x46
Starting Address Hi	0x08	0x08	“08”	0x30, 0x38
Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Outputs Lo	0x02	0x02	“02”	0x30, 0x32
Error Check (CRC/LRC)	-	0x43, 0xCE	“DF”	0x44, 0x46
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

In case of address 0x0800, 0x0801 output register value: 0x0000, 0x0000 changes to 0x1122, 0x3344.

5.1.10 23 (0x17) Read/Write Multiple Registers

This function code performs a combination of one read operation and one write operation in a single MODBUS transaction. The write operation is performed before the read. The request specifies the starting address and number of holding registers to be read as well as the starting address, number of holding registers, and the data to be written. The byte count specifies the number of bytes to follow in the write data field.

The normal response contains the data from the group of registers that were read. The byte count field specifies the quantity of bytes to follow in the read data field.

Table 73: Read/Write Multiple Registers Request

Field name	Example	RTU	ASCII	ASCII (bus line)
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x17	0x17	“17”	0x31, 0x37
Read Starting Address Hi	0x08	0x08	“08”	0x30, 0x38
Read Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Read Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Read Lo	0x02	0x02	“02”	0x30, 0x32
Write Starting Address Hi	0x08	0x08	“08”	0x30, 0x38
Write Starting Address Lo	0x00	0x00	“00”	0x30, 0x30
Quantity of Write Hi	0x00	0x00	“00”	0x30, 0x30
Quantity of Write Lo	0x02	0x02	“02”	0x30, 0x32
Byte Count	0x04	0x04	“04”	0x30, 0x34
Write Reg. Value #0 Hi	0x11	0x11	“11”	0x31, 0x31
Write Reg. Value #0 Lo	0x22	0x22	“22”	0x32, 0x32
Write Reg. Value #1 Hi	0x33	0x33	“33”	0x33, 0x33
Write Reg. Value #1 Lo	0x44	0x44	“44”	0x34, 0x34
Error Check (CRC/LRC)	-	0x88, 0x3F	“20”	0x32, 0x30
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

Table 74: Read/Write Multiple Registers Response

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x17	0x17	“17”	0x31, 0x37
Byte Count	0x04	0x04	“04”	0x30, 0x34
Write Reg. Value #0 Hi	0x11	0x11	“11”	0x31, 0x31
Write Reg. Value #0 Lo	0x22	0x22	“22”	0x32, 0x32
Write Reg. Value #1 Hi	0x33	0x33	“33”	0x33, 0x33
Write Reg. Value #1 Lo	0x44	0x44	“44”	0x34, 0x34
Error Check (CRC/LRC)	-	0x2E, 0xD2	“34”	0x33, 0x34
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

In case of address 0x0800, 0x0801 output register value: 0x0000, 0x0000 changes to 0x1122, 0x3344.

5.2 Error Response

In an exception response, the server sets the MSB of the function code to 1. This makes the function code value in an exception response exactly 80 hexadecimal higher than the value would be for a normal response.

5.2.1 Exception Response Example

Table 75: Exception response Example

<i>Field name</i>	<i>Example</i>	<i>RTU</i>	<i>ASCII</i>	<i>ASCII (bus line)</i>
Start of Frame	-	t1-t2-t3	“ ”	0x3A
Slave Address	0x07	0x07	“07”	0x30, 0x37
Function Code	0x81	0x81	“81”	0x38, 0x31
Exception Code	0x02	0x02	“02”	0x30, 0x32
Error Check (CRC/LRC)	-	0x22, 0xC0	“76”	0x37, 0x36
End of Frame	-	t1-t2-t3	CR, LF	0x0D, 0xA

5.2.2 Exception Codes

Table 76: Exception code description

<i>Exception Code</i>	<i>Name</i>	<i>Description</i>
01	Illegal Function	The function code received in the query is not an allowable action for the server (or slave).
02	Illegal Data Address	The data address received in the query is not an allowable address for the server (or slave).
03	Illegal Data Value	A value contained in the query data field is not an allowable value for server (or slave).
04	Slave Device Failure	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.
05	Acknowledge	The server (or slave) has accepted the request and is processing it, but a long duration of time will be required to do so.
06	Slave Device Busy	Specialized use in conjunction with programming commands. The server (or slave) is engaged in processing a long-duration program command. The client (or master) should retransmit the message later when the server (or slave) is free.
08	Memory Parity Error	The server (or slave) attempted to read record file, but detected a parity error in the memory. The client (or master) can retry the request, but service may be required on the server (or slave) device.
0A**	Gateway Path Unavailable	Specialized use in conjunction with gateways, indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing the request.

** Applicable only for STXMBE001

5.3 MODBUS Special Register Map

The special register map can be accessed by function code 3, 4, 6 and 16. Also the special register map must be accessed by read/write of every/each address (one address).

5.3.1 Adapter Identification Special Register (0x1000, 4096**)

Table 77: Adapter identification description

Address	Access	Type, Size	Description
0x1000(4096)	Read	1 word	Vendor ID = 0x0146(326)
0x1001(4097)	Read	1 word	Device type = 0x000C, Network Adapter
0x1002(4098)	Read	1 word	Product code. 0x0300 (STXMBS001) 0x0301 (STXMBS002) 0x0200 (STXMBE001)
0x1003(4099)	Read	1 word	Firmware revision, if 0x1400, revision 20.00
0x1004(4100)	Read	2 words	Product unique serial number
0x1005(4101)	Read	String up to 34bytes	Product name string First 1word is length of valid character string Example) response as following "00,1C,53,54,58,4D,42,45,30,30,31,2C,4D,4F,44,42,55,53,2F,54,43,50,20,41,64,61,70,74,65,72,00,00,00,00" Valid character size = 0x001C =28 characters "STXMBE001,MODBUS/TCP Adapter"
0x1006(4102)	Read	1 word	Sum check of EEPROM
0x1010(4112)	Read	2 words	Reserved.
0x1011(4113)	Read	2 words	Reserved.
0x1012(4114)	Read	String up to 34bytes	Vendor name string First 1word is length of valid character string. Example: "00,18,47,45,20,49,6E,74,65,6C,6C,69,67,65,6E,74,20,50,6C,61,74,66,6F,72,6D,73,00,00,00,00,00,00,00,00" "GE Intelligent Platforms"
0x101E(4126)	Read	7 words - 1 word - 1 word - 1 word - 1 word - 1 word - 2 words	Composite Id of following address 0x1100(4352), Rotary switch value, Slave Node Id. 0x1000(4096), Vendor ID 0x1001(4097), Device type 0x1002(4098), Product code 0x1003(4099), Firmware revision 0x1004(4100), Product serial number

String Type consists of valid string length (first 1word) and array of characters.

*** Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

5.3.2 Adapter Watchdog Time, other Time Special Register (0x1020, 4128***)

A watchdog timer can be configured for timeout periods up to 65535(1unit=100msec). The Watchdog timer will timeout (timer decreased, reached 0) if MODBUS operation to the slave node does not occur over the configured watchdog value, then the slave adapter forces that slot output value is automatically set to user-configured fault actions and values.

Table 78: Watchdog Timer Description

Address	Access	Type, Size	Description
0x1020(4128)	Read/Write	1 word	Watchdog time value 16bit unsigned. The time value is represented by multiples of 100msec. The default value is 50 (50*100msec=5sec). A changing of watchdog time value resets watchdog error.
0x1021(4129)	Read	1 word	Watchdog time remain value This value decreases every 100msec
0x1022(4130)	Read	1 word	Watchdog error counter, it is cleared by writing address 0x1020
0x1023(4131)	Read/Write	1 word	Enable/disable auto recovery Watchdog error when receiving new frame. 0: Disable, 1: Enable (default). Its value is stored in EEPROM.
0x1024(4132)* ¹	Read/Write	1 word	Transmission response delay time. The value can be set 16bit unsigned (1msec unit). The default value is 0 (no delay).
0x1025(4133)* ¹	Read/Write	1 word	Valid byte-byte time gap in ASCII mode. (1msec unit) In ASCII mode byte-byte time gap is over setting value during receiving frame, this frame will be cancelled (dropped).
0x1028(4136)	Read	2 words	IO update time, main loop time. (100usec unit)

*¹ Not Applicable for STXMBE001

*** Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

5.3.3 Adapter Information Special Register (0x1100, 4352***)

Table 79: Adapter Information Special Register Description

Address	Access	Type, Size	Description
0x1100(4352)* ¹	Read/Write	1 word	Hi byte is two rotary switch values; low byte is current slave node address. MODBUS slave node address. If two rotary switches value are 0, the slave node address is assigned with last valid address and can be changed by software (1~247).
0x1101(4353)* ¹	Read	1 word	Hi byte is a current dip switch value; low byte is used current setup value.
0x1102(4354)	Read	1 word	Start address of input image word register. =0x0000
0x1103(4355)	Read	1 word	Start address of output image word register. =0x0800
0x1104(4356)	Read	1 word	Size of input image word register.
0x1105(4357)	Read	1 word	Size of output image word register.
0x1106(4358)	Read	1 word	Start address of input image bit. = 0x0000
0x1107(4359)	Read	1 word	Start address of output image bit. =0x1000
0x1108(4360)	Read	1 word	Size of input image bit.
0x1109(4361)	Read	1 word	Size of output image bit.
0x110E(4366)	Read	Up to 33 word	IO module catalog-number. First 1word is for network adapter identity number; 0x9171 for STXMBS001; 0x9173 for STXMBS002; 0x9189 for STXMBE001.
0x1110(4368)	Read	1 word	Number of IO Modules
0x1111(4369)	Read	1 word	Number of active slot
0x1112(4370)	Read	1 word	Number of inactive slot
0x1113(4371)	Read	up to 33 word	IO Module Id. Refer: Appendix B. Product List. First 1word is adapter's module id.
0x1114(4372)*	Read/Write	1 word	Input process image mode. The default value is 2. Valid value range is from 0 to 3. Refer: Example of Input Process Image.
0x1115(4373)*	Read/Write	1 word	Output process image mode. The default value is 0. Valid value range is from 0 to 1. Refer: Example of Output Process Image.
0x1116(4374)**	Read/Write	2 words	Inactive slot list, The corresponding bit represents slot position. 0: Active slot, 1: Inactive slot. Ex) if value is 0x0001, 0x8000, then slot#1,#32 are inactive slots
0x1117(4375)	Read	2 words	Live slot list, The corresponding bit represents slot position. 1: live slot, 0: not live slot
0x1118(4376)	Read	2 words	Alarm slot list. The corresponding bit represents slot position. 1: Alarm slot, 0: Normal slot
0x1119(4377)	Read	1 word	Hi byte is MODBUS status, low byte is Bus status. Refer: Example of Input Process Image.

Address	Access	Type, Size	Description
0x111A(4378)	Write	1 word	Reserved. Adapter Scan command.
0x111B(4379)	Read/Write	1 word	Reserved. IO Status machine.
0x111C(4380)	Read	2 words	Reserved. Runtime fault code.
0x111D(4381)	Read	1 word	Adapter Bus Revision. If 0x013C, Bus Revision is 1.60
0x111E(4382)	Read	1 word	Reserved. Adapter IO identification vendor code.
0x111F(4383)* ²	Read	5 words	LED Display Value and Status Code

*¹ Not Applicable for STXMBE001

*² Applicable only for STXMBE001

*, ** After the system is reset, the new values are set.

** If the IO module location is changed, default values are set automatically.

*** Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

5.3.4 Adapter User SRAM Special Register (0x1200, 4608^{*})*2**

^{*2} Applicable only for STXMBE001

The User SRAM variables allow the user to store temporary values. These registers will be cleared with 0 during the reset. The read/write cycles are not limited.

Address	Access	Type, Size	Description
0x1200(4608)	Read/Write	up to 5 words	Reserved
0x1201(4609)	Read/Write	up to 32 words	User SRAM variable area #0
0x1202(4610)	Read/Write	up to 32 words	User SRAM variable area #1
0x1203(4611)	Read/Write	up to 32 words	User SRAM variable area #2
0x1204(4612)	Read/Write	up to 32 words	User SRAM variable area #3
0x1205(4613)	Read/Write	up to 32 words	User SRAM variable area #4
0x1206(4614)	Read/Write	up to 32 words	User SRAM variable area #5
0x1207(4615)	Read/Write	up to 32 words	User SRAM variable area #6
0x1208(4616)	Read/Write	up to 32 words	User SRAM variable area #7
0x1209(4617)	Read/Write	up to 32 words	User SRAM variable area #8
0x120A(4618)	Read/Write	up to 32 words	User SRAM variable area #9
0x120B(4619)	Read/Write	up to 32 words	User SRAM variable area #10
0x120C(4620)	Read/Write	up to 32 words	User SRAM variable area #11
0x120D(4621)	Read/Write	up to 32 words	User SRAM variable area #12
0x120E(4622)	Read/Write	up to 32 words	User SRAM variable area #13
0x120F(4623)	Read/Write	up to 32 words	User SRAM variable area #14
0x1210(4624)	Read/Write	up to 32 words	User SRAM variable area #15

5.3.5 Adapter TCP/IP Special Register (0x1040, 4160^{***}) *2

*2 Applicable only for STXMBE001

Address	Access	Type, Size	Description
0x1040(4160)	Read	1 word	MODBUS/TCP statistics. Same as input process image's status (1word). Hi byte is MODBUS status, low byte is Bus status.
0x1041(4161)	Read/Write	1 word	MODBUS/TCP connection timeout time. (0.5sec unit) Maximum time of MODBUS connection to stay to be opened without receiving a MODBUS request. 0~3600 The 120 (60sec) is default value. The value 0 disables connection time out specially.
0x1042(4162)	Read	1 word	Number of MODBUS/TCP connected
0x1043(4163)	Read	1 word	MODBUS/TCP port, fixed 502
0x1044(4164)	Read	1 word	Ethernet Interface Speed, 10(10Mbps) or 100(100Mbps)
0x1045(4165)*	Read/Write	1 word	Enable/disable IP address setup using BOOTP. 0 or 1
0x1046(4166)*	Read/Write	1 word	Enable/disable IP address setup using ARP. 0 or 1
0x1050(4176)	Read/Write	2 words	IP address. If 192.168.123.1, then 0xA8C0, 0x017B. After update this value, IP address, Subnet mask and Gateway are applied as new one.
0x1051(4177)	Read/Write	2 words	Subnet mask. If 255.255.255.0, then 0xFFFF, 0x00FF.
0x1052(4178)	Read/Write	2 words	Gateway. If 192.168.123.254, then 0xA8C0, 0xFE7B.
0x1053(4179)	Read	3 words	Ethernet physical address (MAC-ID). If 11-22-33-44-55-66, then 0x2211, 0x4433, 0x6655.

* After the system is reset, the new values are set.

*** Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

5.3.6 IO Module Slot Information Special Register (0x2000, 8192**)

Each IO module slot has 0x20(32) address offset and same information structure.

Slot#1	0x2000 (8192) – 0x201F (8223)	Slot#17	0x2200 (8704) – 0x221F (8735)
Slot#2	0x2020 (8224) – 0x203F (8255)	Slot#18	0x2220 (8736) – 0x223F (8767)
Slot#3	0x2040 (8256) – 0x205F (8287)	Slot#19	0x2240 (8768) – 0x225F (8799)
Slot#4	0x2060 (8288) – 0x207F (8319)	Slot#20	0x2260 (8800) – 0x227F (8831)
Slot#5	0x2080 (8320) – 0x209F (8351)	Slot#21	0x2280 (8832) – 0x229F (8863)
Slot#6	0x20A0 (8352) – 0x20BF (8383)	Slot#22	0x22A0 (8864) – 0x22BF (8895)
Slot#7	0x20C0 (8384) – 0x20DF (8415)	Slot#23	0x22C0 (8896) – 0x22DF (8927)
Slot#8	0x20E0 (8416) – 0x20FF (8447)	Slot#24	0x22E0 (8928) – 0x22FF (8959)
Slot#9	0x2100 (8448) – 0x211F (8479)	Slot#25	0x2300(8960) – 0x231F (8991)
Slot#10	0x2120 (8480) – 0x213F (8511)	Slot#26	0x2320 (8992) – 0x233F (9023)
Slot#11	0x2140 (8512) – 0x215F (8543)	Slot#27	0x2340 (9024) – 0x235F (9055)
Slot#12	0x2160 (8544) – 0x217F (8575)	Slot#29	0x2360 (9056) – 0x237F (9087)
Slot#13	0x2180 (8576) – 0x219F (8607)	Slot#20	0x2380 (9088) – 0x239F (9119)
Slot#14	0x21A0 (8608) – 0x21BF (8639)	Slot#30	0x23A0 (9120) – 0x23BF (9151)
Slot#15	0x21C0 (8640) – 0x21DF (8671)	Slot#31	0x23C0 (9152) – 0x23DF (9183)
Slot#16	0x21E0 (8672) – 0x21FF (8703)	Slot#32	0x23E0 (9184) – 0x23FF (9215).

** Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

Table 80: IO Module Slot Information

Address Offset	IO Module Slot#1	IO Module Slot#2	IO Module Slot#3	.....	IO Module Slot#31	IO Module Slot#32
+ 0x00(+0)	0x2000(8192)	0x2020(8224)	0x2040(8256)	.....	0x23C0(9152)	0x23E0(9184)
+ 0x01(+1)	0x2001(8193)	0x2021(8225)	0x2041(8257)	.....	0x23C1(9153)	0x23E1(9185)
+ 0x02(+2)	0x2002(8194)	0x2022(8226)	0x2042(8258)	.....	0x23C2(9154)	0x23E2(9186)
+ 0x03(+3)	0x2003(8195)	0x2023(8227)	0x2043(8259)	.....	0x23C3(9155)	0x23E3(9187)
+ 0x04(+4)	0x2004(8196)	0x2024(8228)	0x2044(8260)	.....	0x23C4(9156)	0x23E4(9188)
+ 0x05(+5)	0x2005(8197)	0x2025(8229)	0x2045(8261)	.....	0x23C5(9157)	0x23E5(9189)
+ 0x06(+6)	0x2006(8198)	0x2026(8230)	0x2046(8262)	.....	0x23C6(9158)	0x23E6(9190)
+ 0x07(+7)	0x2007(8199)	0x2027(8231)	0x2047(8263)	.....	0x23C7(9159)	0x23E7(9191)
+ 0x08(+8)	0x2008(8200)	0x2028(8232)	0x2048(8264)	.....	0x23C8(9160)	0x23E8(9192)
+ 0x09(+9)	0x2009(8201)	0x2029(8233)	0x2049(8265)	.....	0x23C9(9161)	0x23E9(9193)
+ 0x0A(+10)	0x200A(8202)	0x202A(8234)	0x204A(8266)	.....	0x23CA(9162)	0x23EA(9194)
+ 0x0B(+11)	0x200B(8203)	0x202B(8235)	0x204B(8267)	.....	0x23CB(9163)	0x23EB(9195)
+ 0x0C(+12)	0x200C(8204)	0x202C(8236)	0x204C(8268)	.....	0x23CC(9164)	0x23EC(9196)
+ 0x0D(+13)	0x200D(8205)	0x202D(8237)	0x204D(8269)	.....	0x23CD(9165)	0x23ED(9197)
+ 0x0E(+14)	0x200E(8206)	0x202E(8238)	0x204E(8270)	.....	0x23CE(9166)	0x23EE(9198)
+ 0x0F(+15)	0x200F(8207)	0x202F(8239)	0x204F(8271)	.....	0x23CF(9167)	0x23EF(9199)
+ 0x10(+16)	0x2010(8208)	0x2030(8240)	0x2050(8272)	.....	0x23D0(9168)	0x23F0(9200)
+ 0x11(+17)	0x2011(8209)	0x2031(8241)	0x2051(8273)	.....	0x23D1(9169)	0x23F1(9201)
+ 0x12(+18)	0x2012(8210)	0x2032(8242)	0x2052(8274)	.....	0x23D2(9170)	0x23F2(9202)
+ 0x13(+19)	0x2013(8211)	0x2033(8243)	0x2053(8275)	.....	0x23D3(9171)	0x23F3(9203)
+ 0x14(+20)	0x2014(8212)	0x2034(8244)	0x2054(8276)	.....	0x23D4(9172)	0x23F4(9204)
+ 0x15(+21)	0x2015(8213)	0x2035(8245)	0x2055(8277)	.....	0x23D5(9173)	0x23F5(9205)
+ 0x16(+22)	0x2016(8214)	0x2036(8246)	0x2056(8278)	.....	0x23D6(9174)	0x23F6(9206)
+ 0x17(+23)	0x2017(8215)	0x2037(8247)	0x2057(8279)	.....	0x23D7(9175)	0x23F7(9207)
+ 0x18(+24)	0x2018(8216)	0x2038(8248)	0x2058(8280)	.....	0x23D8(9176)	0x23F8(9208)
+ 0x19(+25)	0x2019(8217)	0x2039(8249)	0x2059(8281)	.....	0x23D9(9177)	0x23F9(9209)
+ 0x1A(+26)	0x201A(8218)	0x203A(8250)	0x205A(8282)	.....	0x23DA(9178)	0x23FA(9210)
+ 0x1B(+27)	0x201B(8219)	0x203B(8251)	0x205B(8283)	.....	0x23DB(9179)	0x23FB(9211)
+ 0x1C(+28)	0x201C(8220)	0x203C(8252)	0x205C(8284)	.....	0x23DC(9180)	0x23FC(9212)
+ 0x1D(+29)	0x201D(8221)	0x203D(8253)	0x205D(8285)	.....	0x23DD(9181)	0x23FD(9213)
+ 0x1E(+30)	0x201E(8222)	0x203E(8254)	0x205E(8286)	.....	0x23DE(9182)	0x23FE(9214)
+ 0x1F(+31)	0x201F(8223)	0x203F(8255)	0x205F(8287)	.....	0x23DF(9183)	0x23FF(9215)

Table 81: IO Module Description

Address	Access	Type, Size	Description
+ 0x00(+0)	Read	1 word	IO Module ID. Refer: Appendix B Product List.
+ 0x01(+1)	Read	1 word	IO Module code. Refer: Table IO Data Code Format.
+ 0x02(+2)**	Read	1 word	Input start register address of input image word this slot.
+ 0x03(+3)**	Read	1 word	Input word's bit offset of input image word this slot.
+ 0x04(+4)**	Read	1 word	Output start register address of output image word this slot.

Address	Access	Type, Size	Description
+ 0x05(+5)**	Read	1 word	Output word's bit offset of output image word this slot.
+ 0x06(+6)**	Read	1 word	Input bit start address of input image bit this slot.
+ 0x07(+7)**	Read	1 word	Output bit start address of output image bit this slot.
+ 0x08(+8)**	Read	1 word	Size of input bit this slot
+ 0x09(+9)**	Read	1 word	Size of output bit this slot
+ 0x0A(+10)**	Read	n words	Read input data this slot
+ 0x0B(+11)**	Read/Write	n words	Read/write output data this slot
+ 0x0C(+12)*	Read/Write	1 word	Inactive slot, 0x0000:active, 0x0001:inactive
+ 0x0E(+14)	Read	1 word	ST-number, if ST-1324, returns 0x1324
+ 0x0F(+15)	Read	String up to 74 words	First 1 word is length of valid character string. If ST-221F, returns "00,27,53,54,2D,32,32,31,46,2C,20,47,45,49,50,20,31,36,20,53,69,6E,6B,69,6E,67,20,4F,75,74,20,32,34,56,64,63,20,30,2E,33,41" Valid character size = 0x0027 =39 characters, "ST-221F, GEIP 16 Sinking Out 24Vdc"
+ 0x10(+16)	Read	1 word	Size of configuration parameter byte
+ 0x11(+17)**	Read/Write	n words	Read/write Configuration parameter data, up to 8byte. Refer to "Configuration Parameter and Memory Register" in the <i>PACSystems RSTi IO Manual</i> , GFK-2745
+ 0x12(+18)	Read	1 word	Size of memory byte.
+ 0x13(+19)**	Read/Write	n words	Read/write Memory data. Offset of memory is fixed with 0.
+ 0x14(+20)**	Read/Write	n words	Reserved.
+ 0x15(+21)	Read	2 words	Product code Refer: Appendix B. Product List.
+ 0x16(+22)	Read	2 words	Catalog number. Refer: Appendix B. Product List.
+ 0x17(+23)	Read	1 word	Firmware Revision
+ 0x18(+24)	Read	1 word	Bus Revision
+ 0x1A(+26)	Read/Write	n words	Reserved. Read/write expansion class access.
+ 0x1B(+27)	Read/Write	n words	Reserved. Read/write maintenance data access.

* After the system is reset, the new values are set.

** None of output, input, and memory or configuration parameter corresponding slot returns Exception 02.

*** IO module Configuration parameter saved by internal EEPROM until slot position changed.

*** All of output modules and special modules have the slot configuration parameter data. Refer: Refer to "Configuration Parameter and Memory Register" in GFK-2745.

Note: In term of decimal notation some Modbus masters read register address with +1 offset, e.g.: 0x1000 = 4096 +1 =4097.

5.3.7 IO Data Code Format (1 word)

Table 82: IO Data Code Format

Item	#15	#14	#13	#12	#11	#10	#9	#8	#7	#6	#5	#4	#3	#2	#1	#0	Word
Field	Output IO code								Input IO code								
Field	Date Type				Data Length				Date Type				Data Length				
<i>(Example)</i>																	
ST-3214	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0x0084
ST-1224	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0x00C4
ST-1228	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0x0041
ST-4123	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0x8200
ST-221F	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0x4200
ST-2324	1	1	0	0	0	1	0	0	1	1	0	0	0	1	0	0	0xC4C4

Input/Output Data Type	Input/Output Data Length
0 0: No I/O Data	0 0 0 0 0 0 0: 0 Bit/Byte/Word
0 1: Byte Data	0 0 0 0 0 0 1: 1 Bit/Byte/Word
1 0: Word Data	0 0 0 0 0 1 0: 2 Bit/Byte/Word
1 1: Bit Data	0 0 0 0 0 1 1: 3 Bit/Byte/Word

	1 1 1 1 1 1 1: 63 Bit/Byte/Word

A. Diagnostics

A.1 How to Diagnose when Device Cannot Communicate with the Network

- Verify that cable connections are correct.
- If terminator resistor is not installed, install terminator resistor. Check location of terminator resistor.
- Ensure there are no duplicate node addresses.
- Check configuration of master for port settings, time out, data size etc.
- Power cycle the network adapter to ensure applicability of correct baud rate, parity, byte formats, IO configuration parameters, Input and Output process image modes.
- Check system power & field power connections. Ensure separate power sources are used for system power and Field power. Ensure Network adapter or system power modules are not over loaded.
- Ensure ground cable connections.
- Ensure environment factors are within the limit.

B. Product List

Table 83: Product List

ST-Number	Description	ID(hex)	Production Status
Digital Input Modules			
ST-1114	4 Points, Sink(Positive), 5Vdc	41 00 01	Active
ST-1124	4 Points, Source(Negative), 5Vdc	41 00 02	Active
ST-1214	4 Points, Sink(Positive), 12V/24Vdc	41 00 03	Active
ST-1218	8 Points, Sink(Positive), 12V/24Vdc	41 00 07	Active
ST-121F	16 Points, Sink(Positive), 12V/24Vdc	41 01 13	Active
ST-1224	4 Points, Source(Negative), 12V/24Vdc	41 00 04	Active
ST-1228	8 Points, Source(Negative), 12V/24Vdc	41 00 08	Active
ST-122F	16 Points, Source(Negative), 12V/24Vdc	41 01 14	Active
ST-1314	4 Points, Sink(Positive), 48Vdc	41 00 05	Active
ST-131F	16 Points, Sink(Positive), 48Vdc	41 01 17	Active
ST-1324	4 Points, Source(Negative), 48Vdc	41 00 06	Active
ST-1804	4 Points, 110Vac,	41 00 09	Active
ST-1904	4 Points, 220Vac,	41 00 0A	Active
Digital Output Modules			
ST-2114	4 Points TTL Inverting, 5Vdc/20mA,	81 00 0D	Active
ST-2124	4 Points TTL Non-Inverting, 5Vdc/20mA,	81 00 0F	Active
ST-221F	16 Points Sink(Negative Logic), 24Vdc/0.5A,	81 01 15	Active
ST-222F	16 Points Source(Positive Logic), 24Vdc/0.5A,	81 01 16	Active
ST-2314	4 Points Sink(Negative Logic), 24Vdc/0.5A,	81 00 0E	Active
ST-2318	8 Points Sink(Negative Logic), 24Vdc/0.5A,	81 00 11	Active
ST-2324	4 Points Source(Positive Logic), 24Vdc/0.5A,	81 00 10	Active
ST-2328	8 Points Source(Positive Logic), 24Vdc/0.5A,	81 00 12	Active
ST-2414	4 Points Sink(Negative Logic), 24Vdc/0.5A, Diagnostics	81 00 08	Active
ST-2424	4 Points Source(Positive Logic),24Vdc/0.5A, Diagnostics	C1 00 00 38	Active
ST-2514	4 Points Sink(Negative Logic), 24Vdc/2A, Diagnostics	C1 00 00 35	Active
ST-2524	4 Points Source(Positive Logic), 24Vdc/2A, Diagnostics	C1 00 00 36	Active
ST-2614	4 Points Sink(Negative Logic), 24Vdc/2A,	81 00 3B	Under Development
ST-2624	4 Points Source(Positive Logic), 24Vdc/2A,	81 00 3C	Under Development
ST-2742	2 Points, 230Vac/2A, 24Vdc/2A, Relay	81 00 0B	Active
ST-2744	4 Points, 230Vac/2A, 24Vdc/2A, Relay	81 00 51	Active
ST-2748	8 Points, 230Vac/2A, 24Vdc/2A, Relay	81 00 50	Active
ST-2792	2 Points, 230Vac/2A, 24Vdc/2A, Relay, Manual/Auto	C1 00 01 BE	Under Development
ST-2852	2 Points, 12~125Vac/0.5A, Triac	81 00 0C	Active

Appendix B. Product List

ST-Number	Description	ID(hex)	Production Status
Analog Input Modules			
ST-3114	4 Channels, Current, 0~20mA, 12bit	41 43 1C	Active
ST-3118	8 Channels, Current, 0~20mA, 12bit	41 47 82	Active
ST-3134	4 Channels, Current, 0~20mA, 14bit	41 43 1E	Active
ST-3214	4 Channels, Current, 4~20mA, 12bit	41 43 1D	Active
ST-3218	8 Channels, Current, 4~20mA, 12bit	41 47 83	Active
ST-3234	4 Channels, Current, 4~20mA, 14bit	41 43 1F	Active
ST-3274	4 Channels, Current, 4~20mA, 12bit, Sensor Connector	41 43 A3	Under Development
ST-3424	4 Channels, Voltage, 0~10Vdc, 12bit	41 43 20	Active
ST-3428	8 Channels, Voltage, 0~10Vdc, 12bit	41 47 22	Active
ST-3444	4 Channels, Voltage, 0~10Vdc, 14bit	41 43 22	Active
ST-3524	4 Channels, Voltage, -10Vdc~10Vdc, 12bit	41 43 21	Active
ST-3544	4 Channels, Voltage, -10Vdc~10Vdc, 14bit	41 43 23	Active
ST-3624	4 Channels, Voltage, 0~5Vdc, 12bit	41 43 24	Active
ST-3644	4 Channels, Voltage, 0~5Vdc, 14bit	41 43 25	Active
ST-3702	2 Channels, RTD, Status	41 41 28	Active
ST-3704	4 Channels, RTD, Status	41 43 64	Active
ST-3708	8 Channels, RTD, Status	41 47 65	Active
ST-3802	2 Channels, TC	41 41 2A	Active
ST-3804	4 Channels, TC	41 43 66	Active
ST-3808	8 Channels, TC	41 47 67	Active
Analog Output Modules			
ST-4112	2 Channels, Current, 0~20mA, 12bit	81 41 2C	Active
ST-4114	4 Channels, Current, 0~20mA, 12bit	81 43 6D	Active
ST-4212	2 Channels, Current, 4~20mA, 12bit	81 41 2D	Active
ST-4214	4 Channels, Current, 4~20mA, 12bit	81 43 6E	Active
ST-4274	4 Channels, Current, 4~20mA, 12bit, Sensor Connector	81 43 B3	Under Development
ST-4422	2 Channels, Voltage, 0~10Vdc, 12bit	81 41 2E	Active
ST-4424	4 Channels, Voltage, 0~10Vdc, 12bit	81 43 6A	Active
ST-4474	4 Channels, Voltage, 0~10Vdc, 12bit, Sensor Connector	81 43 B0	Under Development
ST-4491	1 Channel, Voltage, 0~10Vdc, 12bit, Manual Type	C1 40 41 BF	Active
ST-4522	2 Channels, Voltage, -10~10Vdc, 12bit	81 41 2F	Active
ST-4622	2 Channels, Voltage, 0~5Vdc, 12bit	81 41 30	Active
ST-4911	1 Channel, Current, 0~1A, 12bit	81 40 31	Active

ST-Number	Description	ID(hex)	Production Status
Special Modules			
ST-5101	1 Channel, High Speed Counter, 5V Input	C1 01 05 34	Active
ST-5111	1 Channel, High Speed Counter, 24V Input	C1 01 05 39	Active
ST-5112	2 Channel, High Speed Counter, 24V Sink Input	C1 01 07 4D	Active
ST-5114	4 Channel, High Speed Counter, 24V Sink Input	C1 03 0F 4C	Active
ST-5211	RS232 Communication, 1Channel, RTS/CTS Flow Control	C1 05 05 42	Active
ST-5212	RS232 Communication, 2Channel	C1 0B 0B 43	Active
ST-5221	RS422 Communication, 1Channel	C1 05 05 44	Active
ST-5231	RS485 Communication, 1Channel	C1 05 05 45	Active
ST-5232	RS485 Communication, 2Channel	C1 0B 0B 46	Active
ST-5252	RS2-2 Communication, 2 Channel		Under Development
ST-5272	RS-485 Communication, 2 Channel		Under Development
ST-5351	SSI Interface 1CH	C1 01 09 9E	Active
ST-5422	2 CH PWM output, 1.5A/24Vdc, source	C1 05 01 57	Active
ST-5442	2 CH PWM output, 0.5A/24Vdc, source	C1 05 01 56	Active
ST-5444	4 CH PWM output, 0.5A/24Vdc, source	C1 0B 03 54	Active
ST-5641	1 CH Pulse output, 0.5A/24Vdc, source	C1 05 03 92	Active
ST-5642	2 CH Pulse output, 0.5A/24Vdc, source	C1 09 07 90	Active
ST-5651	1 CH Pulse output, RS422	C1 05 03 98	Active
Power Modules			
ST-7408	8 Channels, Shield, ID Type	02 00 E4	Active
ST-7508	8 Channels, Common, 0Vdc, ID Type	02 00 E5	Active
ST-7511	1 Channel, Expansion Power, Input 24Vdc, Output 1.0A/5Vdc, ID Type	02 00 E0	Active
ST-7518	8 Channels, Common, 24Vdc, ID Type	02 00 E6	Active
ST-7588	8 Channels, Common, 0Vdc and 24Vdc, ID Type	02 00 E7	Active
ST-7641	1 Channel, Field Distributor, 5Vdc~48Vdc, 110Vac~220Vac, ID Type	02 00 E2	Active

C. Product Certifications and Installation Guidelines for Conformance

This appendix describes the compliance markings and standards to which the RSTi products have been certified.

C.1 Important Notes

Solid state equipment has operational characteristics differing from those of electromechanical equipment.

Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls describes some important differences between solid state equipment and hard-wired electromechanical devices.

Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must ensure that each intended application of this equipment is acceptable.

In no event will GE be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, GE cannot assume responsibility or liability for actual use based on the examples and diagrams.

C.2 Safety Notes

Warning

The modules are equipped with electronic components that may be destroyed by electrostatic discharge. When handling the modules, ensure that the environment (persons, workplace and packing) is well grounded. Avoid touching conductive components, for example, RSTi Bus Pin.

C.3 Certifications

cUL_{US} Listed Industrial Control Equipment, certified for U.S. and Canada
See UL File E105285

CE Mark
EN 61000-6-2:2005; Industrial Immunity
EN 61000-6-4:2007; Industrial Emissions

C.4 Government Regulations

U.S., Canadian, Australian, and European regulations are intended to prevent equipment from interfering with approved transmissions or with the operation of other equipment through the AC power source.

The PACSystems RSTi family of products has been tested and found to meet or exceed the requirements of U.S. (47 CFR 15), Canadian (ICES-003), Australian (AS/NZS 3548), and European (EN 61000-6-4:2007) regulations for Class A digital devices when installed in accordance with the guidelines noted in this manual. These various regulations share commonality in content and test levels with that of CISPR 22 and based on this commonality testing to the each individual standard was deemed inappropriate.

The FCC requires the following note to be published according to FCC guidelines:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case user will be required to correct the interference at his own expense.

Industry Canada requires the following note to be published:

Note: This Class A digital apparatus complies with Canadian ICES-003.

C.5 Environmental Specifications

C.5.1 MODBUS STXMBS001

Table 84: Environmental specification for STXMBS001

<i>Items</i>	<i>Specification</i>
Operating Temperature	0°C to 55°C for UL applications ; 0°C to 60°C for non-UL applications
Storage Temperature	Storage -40°C to 85°C
Relative Humidity	90% Non-condensing
Protection Class	IP20
Mounting	DIN Rail

C.5.2 MODBUS STXMBS002

Table 85: Environmental specification for STXMBS002

<i>Items</i>	<i>Specification</i>
Operating Temperature	0°C to 55°C for UL applications ; 0°C to 60°C for non-UL applications
Non-Operating Temperature	Storage -40°C to 85°C
Relative Humidity	90% Non-condensing
Protection Class	IP20
Mounting	DIN Rail

C.5.3 MODBUS STXMBE001

Table 86: Environmental specification for STXMBE001

<i>Items</i>	<i>Specification</i>
Operating Temperature	-20°C to 55°C for UL applications ; -20°C to 60°C for non-UL applications
Non-Operating Temperature	Storage -40°C to 85°C
Relative Humidity	90% Non-condensing
Protection Class	IP20
Mounting	DIN Rail

C.6 Abbreviations

Table 87: Abbreviations

<i>Items</i>	<i>Description</i>
ASCII	American Standard Code for Information Interchange
CRC	Cyclic Redundancy Check
EEPROM	Electrically Erasable Programmable Read Only Memory
ESD	Electrostatic discharge
FG	Frame Ground
GND	Ground
I/O	Input/ Output
LRC	Longitudinal Redundancy Check
MAC	Media Access Control
PDU	Power Drive Unit
TC	Thermocouple
RTD	Resistance Temperature Detector
RTU	Remote terminal unit
RXD	Received data
TXD	Transmit data
TCP/IP	Transfer control protocol / Internet protocol
ARP	Address resolution protocol

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