



Modbus Adapter User Manual
FnIO S-Series
NA-9171

List of Revisions

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1. Product Specifications

1) General Specifications

| Item | | Specifications | Remarks |
|--------------------|-----------|---|---------|
| Temperature | Operating | 0°C to +60°C (32°F to 140°F) | |
| | Storage | -40°C to +85°C (-40°F to 185°F) | |
| Humidity | Operating | 5 to 95% RH (Non-condensing) | |
| | Storage | 5 to 95% RH (Non-condensing) | |
| Vibration immunity | | 10 TO 55Hz, double amplitude of 0.75mm, 10minutes on each of 3 axes (X,Y,Z) | |
| Shock Immunity | | Peak acceleration and duration 15g/11ms, 3 times on each of 3 axes (X,Y,Z) | |
| Capsuling | | Din rail or screw tightening | |

2) MODBUS RS232C Communication Specification

| Item | Specification | Remarks |
|-------------------------|--|--------------------|
| Network Protocol | RTU and ASCII | |
| Network length | 15m(RS-232C) | |
| Number of Nodes | 1 Node | |
| Communication speed | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200bps | Dip Switch Setting |
| Number of Expansion I/O | Max. 32 Slots | |
| Interface Connector | Dsub 9Pin (Female) | |
| Settable Node Address | 1~99 with two rotary switches | |
| Indicator | 5 LEDs 1Green/Red, Module Status (MOD) 1Green, Received Data (RXD) 1Green, Transmit Data (TXD) 1Green/Red, Expansion Module Status (I/O) 1Green, Field Power Status | |
| System Power | Supply voltage : 24Vdc nominal Supply voltage range : 11~28.8Vdc Protection : Output current limit (Min.1.5A) Reverse polarity protection | |
| Isolation | System power to internal logic : Non-isolation System power to I/O Driver : Isolation | |

2. MODBUS Setting

MODBUS setting include the following configurations:

- Communication parameter setting
- I/O allocation
- MODBUS Interface

1) Communication Parameter Setting

◆ Node Address Setting

- NA-9171 Node address is determined by the node address rotary switch on the front panel of adapter module.
- Set node address is recognized on the power-on of adapter module.

Ex) When node address is set as 27:

Device MAC ID Setting : (2*10 + 1*7)= 27



X 10 (MSD)¹⁾



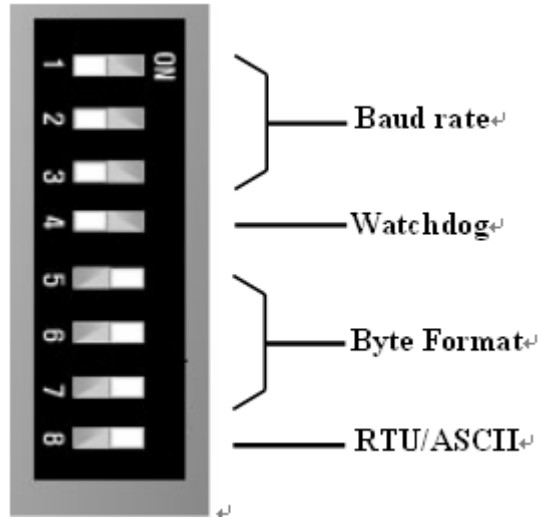
X 1 (LSD)¹⁾

* Each MODBUS Adaptor has MAC ID No. from 0 to 99.



◆ **Communication Speed Setting**

Setting MODBUS Adapter Interface Configuration with 8 Pole DIP Switch



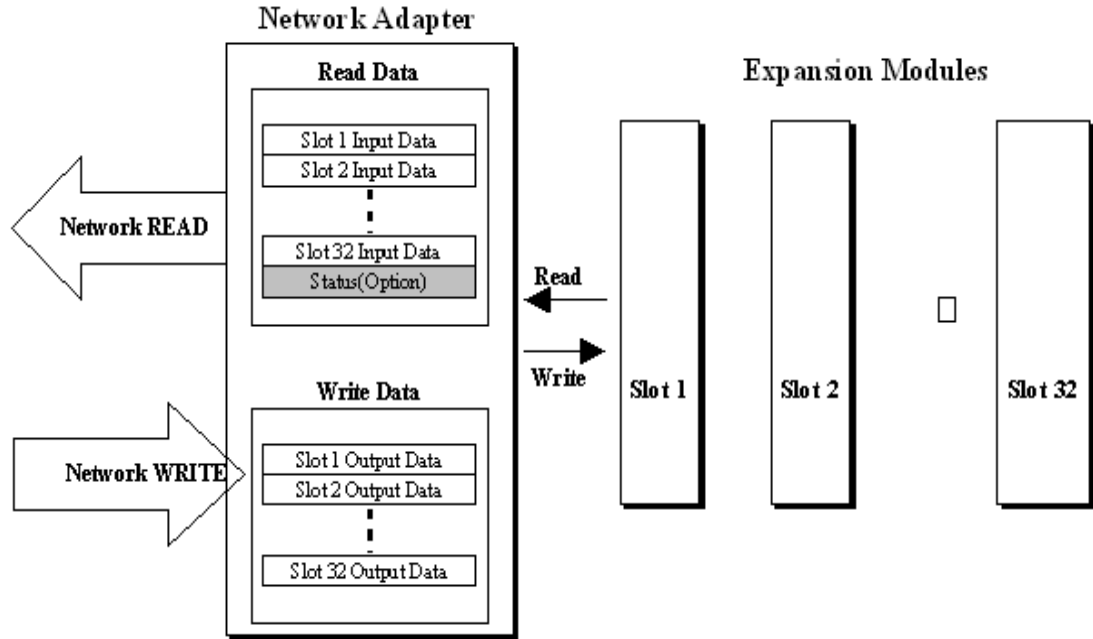
◆ **Dip Switch Setting**

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

* possible in ASCII Mode only

2) I/O Allocation

An expansion module may have 3 types of data as I/O data, configuration parameter and memory resister. The data exchange between network adapter and expansion modules is done via an I/O process image data by FnBus protocol. The following figure shows the data flow of process image between network adapter and expansion modules.



MODBUS Interface Resister/Bit Map

◆ Resister Map

| Start Address | Read/Write | Description |
|---------------|------------|--|
| 0x0000 | Read | Process Input image registers |
| 0x0800 | Read/Write | Process output image registers |
| 0x1000* | Read | Adapter Identification special registers. |
| 0x1020* | Read/Write | Adapter Watchdog, other time special register. |
| 0x1100* | Read/Write | Adapter Information special registers. |
| 0x2000* | Read/Write | Expansion Slot Information Special registers |

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

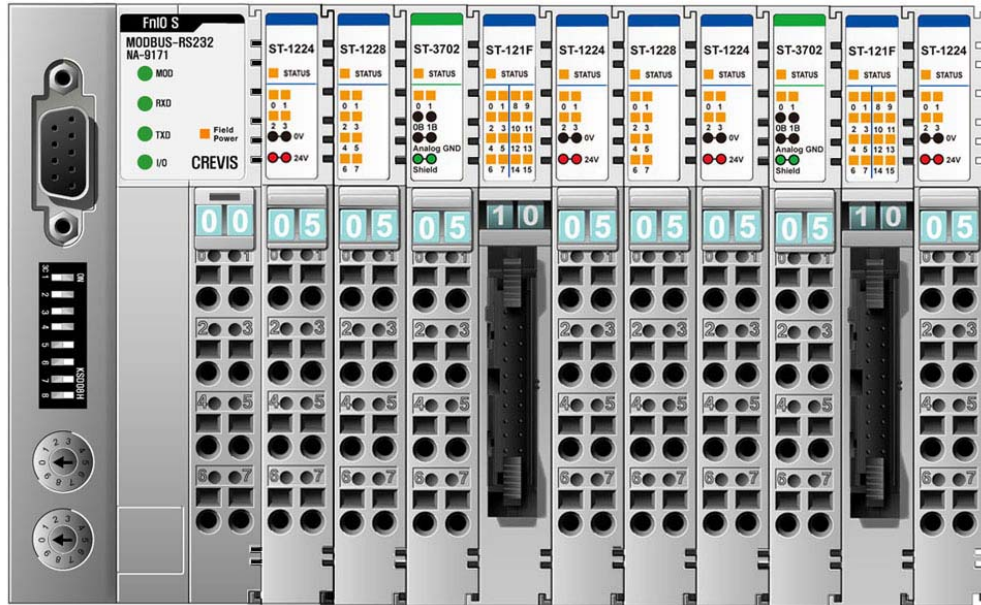
◆ Bit Map

| Start Address | Read/Write | Description |
|---------------|------------|---|
| 0x0000 | Read | Process input image bits All input registers area are addressable by bit address. Size of input image bit is of input image register |
| 0x1000 | Read/Write | Process output image bits All output registers area are addressable by bit address. Size of output image bit is size of output image register |



◆ For Example of Input Process Image Data

Input image data depends on slot position and expansion slot data type. Input process image data is only ordered by expansion slot 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 expansion slot position and slot data type.



| Slot Address | Module Description |
|--------------|--------------------|
| 0 | MODBUS Adaptor |
| 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 |



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

| WORD# | #15 | #14 | #13 | #12 | #11 | #10 | #9 | #8 | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|-------|--------------------------------------|-----|-----|-----|----------------------------------|-----|----|----|--------------------------------------|--------------|----|----|---------------------------------|----|----|----|
| +0 | EW | EC | 0 | 0 | 0 | 0 | 0 | ES | FP | FnBUS Status | | | | | | |
| +1 | Discrete Input 8points (slot#2) | | | | | | | | Empty, Always 0 | | | | Discrete Input 4points (slot#1) | | | |
| +2 | Analog Input CH0 High byte (slot#3) | | | | | | | | Analog Input CH0 low byte (slot#3) | | | | | | | |
| +3 | Analog Input CH1 High byte (slot#3) | | | | | | | | Analog Input CH1 low byte (slot#3) | | | | | | | |
| +4 | Discrete Input high 8points (slot#4) | | | | | | | | Discrete Input low 8points (slot#4) | | | | | | | |
| +5 | Discrete Input 8points (slot#6) | | | | | | | | Empty, Always 0 | | | | Discrete Input 4points (slot#5) | | | |
| +6 | Analog Input CH0 low byte (slot#8) | | | | | | | | Empty, Always 0 | | | | Discrete Input 4points (slot#7) | | | |
| +7 | Analog Input CH1 low byte (slot#8) | | | | | | | | Analog Input CH0 high byte (slot#8) | | | | | | | |
| +8 | Discrete Input low 8points (slot#9) | | | | | | | | Analog Input CH1 high byte (slot#8) | | | | | | | |
| +9 | Empty, Always 0 | | | | Discrete Input 4points (slot#10) | | | | Discrete Input high 8points (slot#9) | | | | | | | |

● **FnBus Status:**

- 0 : Normal Operation
- 1 : FnBus Standby
- 2 : FnBus Communication Fault
- 3 : Slot Configuration Failed
- 4 : No Expansion Slot

● **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.

◆ **Input Process Image Mode#1**

(Status(1word) + compressed Input Processing Data)

| WORD# | #15 | #14 | #13 | #12 | #11 | #10 | #9 | #8 | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|-------|--------------------------------------|-----|-----|-----|------------------------------------|-----|----|----|--------------------------------------|--------------|----|----|------------------------------------|----|----|----|
| +0 | EW | EC | 0 | 0 | 0 | 0 | 0 | ES | FP | FnBUS Status | | | | | | |
| +1 | Analog Input CH0 High byte (slot#3) | | | | | | | | Analog Input CH0 low byte (slot#3) | | | | | | | |
| +2 | Analog Input CH1 High byte (slot#3) | | | | | | | | Analog Input CH1 low byte (slot#3) | | | | | | | |
| +3 | Analog Input CH0 high byte (slot#8) | | | | | | | | Analog Input CH0 low byte (slot#8) | | | | | | | |
| +4 | Analog Input CH1 high byte (slot#8) | | | | | | | | Analog Input CH1 low byte (slot#8) | | | | | | | |
| +5 | Discrete Input low 8points (slot#4) | | | | | | | | Discrete Input 8points (slot#2) | | | | | | | |
| +6 | Discrete Input 8points (slot#6) | | | | | | | | Discrete Input high 8points (slot#4) | | | | | | | |
| +7 | Discrete Input high 8points (slot#9) | | | | | | | | Discrete Input low 8points (slot#9) | | | | | | | |
| +8 | Discrete Input 4points (Slot#10) | | | | Discrete Input 4points (Slot#7) | | | | Discrete Input 4points (Slot#5) | | | | Discrete Input 4points (Slot#1) | | | |

● **Input Assembly Priority**

- 1) Analog IO Data (Word Type)
- 2) 8 or 16 points Discrete IO Data (Byte Type)
- 3) 4 points IO Data (Bit Type)
- 4) 2 points IO Data (Bit Type)

◆ **Input Process Image Mode#2**

(Uncompressed Input Processing Data without Status), default input image

| WORD# | #15 | #14 | #13 | #12 | #11 | #10 | #9 | #8 | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|-------|--------------------------------------|-----|-----|-----|-------------------------------------|-----|----|----|--------------------------------------|----|----|----|------------------------------------|----|----|----|
| +0 | Discrete Input 8points (slot#2) | | | | | | | | Empty, Always 0 | | | | Discrete Input 4points (slot#1) | | | |
| +1 | Analog Input CH0 High byte (slot#3) | | | | | | | | Analog Input CH0 low byte (slot#3) | | | | | | | |
| +2 | Analog Input CH1 High byte (slot#3) | | | | | | | | Analog Input CH1 low byte (slot#3) | | | | | | | |
| +3 | Discrete Input high 8points (slot#4) | | | | | | | | Discrete Input low 8points (slot#4) | | | | | | | |
| +4 | Discrete Input 8points (slot#6) | | | | | | | | Empty, Always 0 | | | | Discrete Input 4points (slot#5) | | | |
| +5 | Analog Input CH0 low byte (slot#8) | | | | | | | | Empty, Always 0 | | | | Discrete Input 4points (slot#7) | | | |
| +6 | Analog Input CH1 low byte (slot#8) | | | | | | | | Analog Input CH0 high byte (slot#8) | | | | | | | |
| +7 | Discrete Input low 8points (slot#9) | | | | | | | | Analog Input CH1 high byte (slot#8) | | | | | | | |
| +8 | Empty, Always 0 | | | | Discrete Input 4points (slot#10) | | | | Discrete Input high 8points (slot#9) | | | | | | | |



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

| WORD# | #15 | #14 | #13 | #12 | #11 | #10 | #9 | #8 | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|-------|--------------------------------------|-----|-----|------------------------------------|-----|-----|----|--------------------------------------|----|----|------------------------------------|----|----|----|----|----|
| +0 | Analog Input CH0 High byte (slot#3) | | | | | | | Analog Input CH0 low byte (slot#3) | | | | | | | | |
| +1 | Analog Input CH1 High byte (slot#3) | | | | | | | Analog Input CH1 low byte (slot#3) | | | | | | | | |
| +2 | Analog Input CH0 high byte (slot#8) | | | | | | | Analog Input CH0 low byte (slot#8) | | | | | | | | |
| +3 | Analog Input CH1 high byte (slot#8) | | | | | | | Analog Input CH1 low byte (slot#8) | | | | | | | | |
| +4 | Discrete Input low 8points (slot#4) | | | | | | | Discrete Input 8points (slot#2) | | | | | | | | |
| +5 | Discrete Input 8points (slot#6) | | | | | | | Discrete Input high 8points (slot#4) | | | | | | | | |
| +6 | Discrete Input high 8points (slot#9) | | | | | | | Discrete Input low 8points (slot#9) | | | | | | | | |
| +7 | Discrete Input 4points (Slot#10) | | | Discrete Input 4points (Slot#7) | | | | Discrete Input 4points (Slot#5) | | | Discrete Input 4points (Slot#1) | | | | | |

*FnBus use the byte-oriented register mapping.

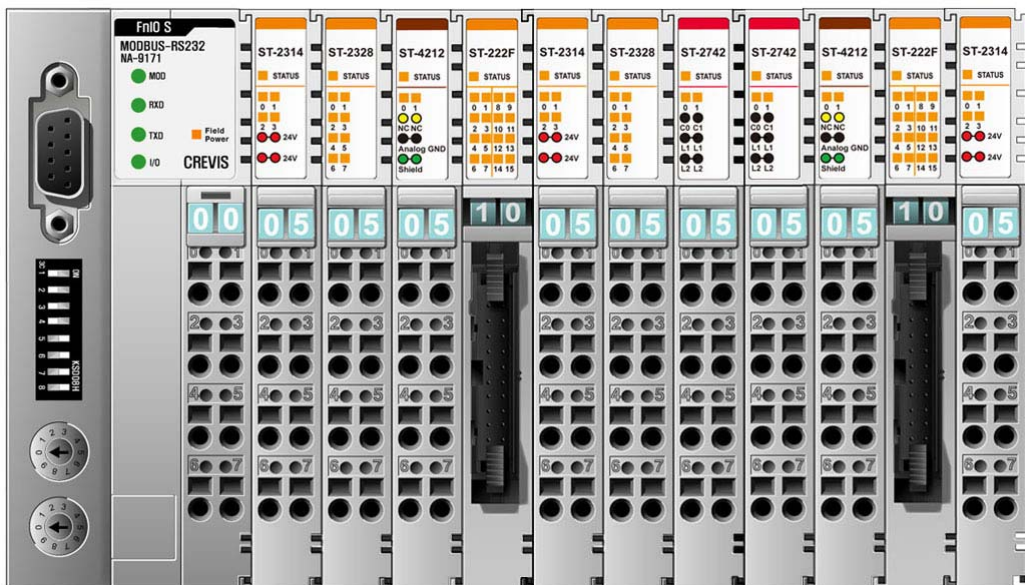
*Size of input image bit is size of input image register

● Input Assembly Priority:

- 1) Analog Input Data (Word type)
- 2) 8 or 16 points Discrete Input Data (Byte type)
- 3) 4 Points Input Data (Bit type)
- 4) 8 Points Input Data (Bit Type)

◆ For Example of Output Process Image Data

Output image data depends on slot position and expansion slot data type. Output process image data is only ordered by expansion 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 expansion slot position and slot data type.



| Slot Address | Module Description |
|--------------|--------------------|
| 0 | MODBUS Adaptor |
| 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 |

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

| WORD# | #15 | #14 | #13 | #12 | #11 | #10 | #9 | #8 | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|-------|---------------------------------------|-----|-----|-----|-----|-----|----------------------------------|--------------------------------------|----|----|----|----------------------------------|----|----|----------------------------------|----|
| +0 | Discrete output 8points(slot#2) | | | | | | | Empty,Don't Care | | | | Discrete output 4points (slot#1) | | | | |
| +1 | Analog output CH0 High byte(slot#3) | | | | | | | Analog output CH0 low byte(slot#3) | | | | | | | | |
| +2 | Analog output CH1 High byte(slot#3) | | | | | | | Analog output CH1 low byte(slot#3) | | | | | | | | |
| +3 | Discrete output high 8points(slot#4) | | | | | | | Discrete output low 8points(slot#4) | | | | | | | | |
| +4 | Discrete output 8points(slot#6) | | | | | | | Empty,Don't Care | | | | Discrete Input 4points (slot#5) | | | | |
| +5 | Empty,Don't Care | | | | | | Discrete output 2points (slot#8) | Empty,Always 0 | | | | | | | Discrete output 2points (slot#7) | |
| +6 | Analog output CH0 high byte(slot#9) | | | | | | | Analog output CH0 low byte(slot#9) | | | | | | | | |
| +7 | Analog output CH1 high byte(slot#9) | | | | | | | Analog output CH1 low byte(slot#9) | | | | | | | | |
| +8 | Discrete Output high 8points(slot#10) | | | | | | | Discrete Output low 8points(slot#10) | | | | | | | | |
| +9 | Empty,Don't care | | | | | | | Empty,Don't care | | | | Discrete Out 4points(Slot#11) | | | | |



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

| WORD# | #15 | #14 | #13 | #12 | #11 | #10 | #9 | #8 | #7 | #6 | #5 | #4 | #3 | #2 | #1 | #0 |
|-------|---------------------------------------|-----|----------------------------------|-----|-----------------------------------|-----|----|----------------------------------|---------------------------------------|----|----------------------------------|----|----|----|----|----|
| +0 | Analog output CH0 High byte (slot#3) | | | | | | | | Analog output CH0 low byte (slot#3) | | | | | | | |
| +1 | Analog output CH1 High byte (slot#3) | | | | | | | | Analog output CH1 low byte (slot#3) | | | | | | | |
| +2 | Analog output CH0 high byte (slot#9) | | | | | | | | Analog output CH0 low byte (slot#9) | | | | | | | |
| +3 | Analog output CH1 high byte (slot#9) | | | | | | | | Analog output CH1 low byte (slot#9) | | | | | | | |
| +4 | Discrete output low 8points (slot#4) | | | | | | | | Discrete output 8points (slot#2) | | | | | | | |
| +5 | Discrete output 8points (slot#6) | | | | | | | | Discrete output high 8points (slot#4) | | | | | | | |
| +6 | Discrete Input high 8points (slot#10) | | | | | | | | Discrete Input low 8points (slot#910) | | | | | | | |
| +7 | Discrete output 2points (slot#8) | | Discrete output 2points (slot#7) | | Discrete output 4points (slot#11) | | | Discrete output 4points (slot#5) | | | Discrete output 4points (slot#1) | | | | | |

*FnBus uses the bytes-oriented register mapping.

*Size of output image bit is size of output image register.

● Output Assembly Priority:

- 1) Analog Output Data (Word type)
- 2) 8 or 16 points Discrete Output Data (Byte type)
- 3) 4 Points Output Data (Bit type)
- 4) 2 Points Output Data (Bit Type)

3) MODBUS INTERFACE

◆ MODBUS Transmission Mode

Two different serial transmission modes are defined : The RTU and the ASCII mode. It defines the bit contents of message fields transmitted serially on the line. It determines how information is packed into the message fields and decoded.

◆ RTU Transmission Mode

When devices communicate on a MODBUS serial line using the RTU (Remote Terminal Unit)mode, each 8-bit byte in a message contains two 4-bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII mode for the same baudrate. Each message must be transmitted in a continuous stream of characters.

| Start | Address | Function | Data | CRC Check | End |
|-----------|---------|----------|-------------------|-----------|-----------|
| ≥3.5 char | 1 char | 1 char | Up to 252 char(s) | 2 chars | ≥3.5 char |

◆ ASCII Transmission Mode

When devices are setup to communicate on a MODBUS serial line using ASCII (American Standard Code for Information Interchange) mode, each 8-bit byte in a message is sent as two ASCII characters. This mode is used when the physical communication link or the capabilities of the device dose not allow the conformance with RTU mode requirements regarding timers management.

| Start | Address | Function | Data | LRC Check | End |
|---------|---------|----------|---------------------|-----------|---------------|
| 1 chars | 2 chars | 2 chars | Up to 2x252 char(s) | 2 chars | 2 chars CR,LF |

◆ Support MODBUS Function Codes

| 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 Coil | 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 registers | Read a number of input words / Write a number of output words | Unicast |

3. MODBUS Network Installation

MODBUS RS232C Network Set up is like following figure1.

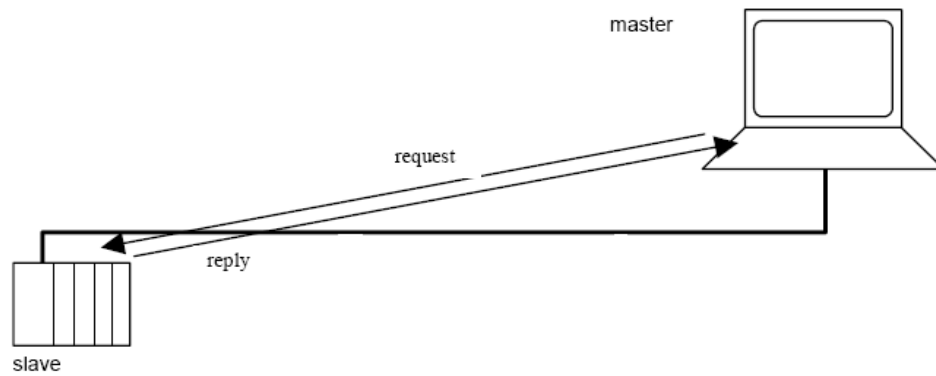


Figure 1 MODBUS Network

1) RS232-MODBUS Electrical Interface

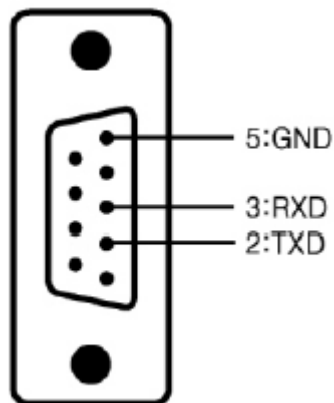


Figure 2 RS232C MODBUS Interface

| Dsub 9 pin | Signal Name | Description |
|------------|-------------|--------------------------|
| 1 | --- | |
| 2 | TXD | Output, Transmitted Data |
| 3 | RXD | Input, Received Data |
| 4 | --- | |
| 5 | GND | Signal Common |
| 6 | --- | |
| 7 | --- | |
| 8 | --- | |
| 9 | --- | |

This RS232-MODBUS on Serial Line System should only be used for short length (typically less than 20m) point to point interconnection

2) Cables

A MODBUS over Serial Line Cable must be Shielded. At One of each cable its shield must be connected to protective ground. If a connector is used at this end, the shell of the connector is connected to the shield of the cable.

3) Data Signaling Rates

9600bps and 19.2kbps are required and 19.2 is the required default Other baud rates may optionally be implemented : 1200, 2400, 4800,...., 38400bps, 57.6kbps, 115.2kbps

4. Check Operation Status

When all installation and configuration processes are complete, the adaptor module status LED (MOD LED) and Communication status LED shall be lit in a green color. If not, it indicates that an error has occurred. See the following table for proper measures.

1) MOD : Module Status LED

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

2) RXD : Received Data LED

| State | LED is | Description |
|--|-------------------|---|
| Not Powered | Off | Device is idle or may be not powered |
| Adapter received correct message frame | Green Flashing | Adapter(Slave) received correct frame which address to the slave or broadcast. About 20msec flashing. |

3) TXD : Transmit Data LED

| State | LED is | Description |
|------------------------|-------------------|---|
| Not Powered | Off | Device is idle or may be not powered |
| Adapter transmit frame | Green Flashing | Adapter(Slave) transmit frame. About 20msec flashing. |

4) I/O : Expansion Module Status LED

| State | LED is | To Indicate |
|---|-------------------|---|
| Not Powered No Expansion Module | Off | Device has no expansion module or may be not powered |
| FnBus Connection Do not Exchanging I/O | Flashing Green | FnBus is Normal but does not exchange I/O data (Passed the expansion module configuration). |
| FnBus Connection, Run Exchange I/O | Green | Exchange I/O data |
| FnBus connection fault During Exchanging I/O | Flashing Red | One or more expansion module occurred in fault state - Changed expansion module configuration - FnBus communication failure |
| Expansion Configuration Failed | Red | Failed to initialize expansion module - Detected invalid expansion module ID. - Overflowed Input/Output Size - Too many expansion module - Initial protocol failure - Mismatch vender code between adapter and expansion module. |

5) Field Power : Field Power Status LED

| State | LED is | To Indicate |
|--------------------------|--------|--------------------------------|
| Not Supplied Field Power | Off | Not supplied 24Vdc field power |
| Supplied Field Power | Green | Supplied 24Vdc field power |

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