



Modbus Adapter User Manual
FnIO S-Series
NA-9173

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, 3times on each of 3 axes (X,Y,Z)	
Capsuling		Din rail or screw tightening	

2) MODBUS RS485 Communication Specification

Item	Specification	Remarks
Network Protocol	RTU and ASCII	
Network length	1200m (RS485)	
Number of Nodes	64 Nodes	
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	5LEDS 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-9173 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)[↵]

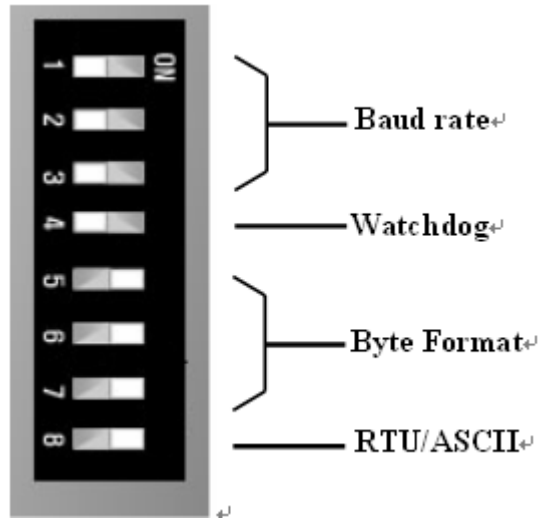


X 1 (LSD)[↵]

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

◆ **Communication Speed Setting**

Setting MODBUS Adapter Interface Configuration with 8 Pole DIP Switch



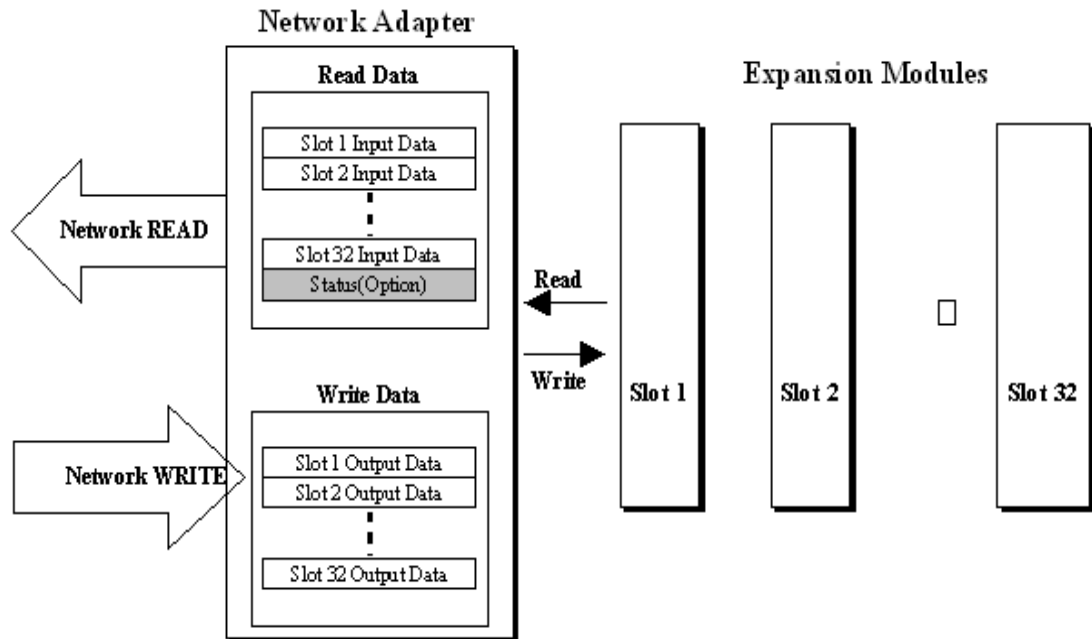
Dip Switch Setting

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.



◆ Register 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)

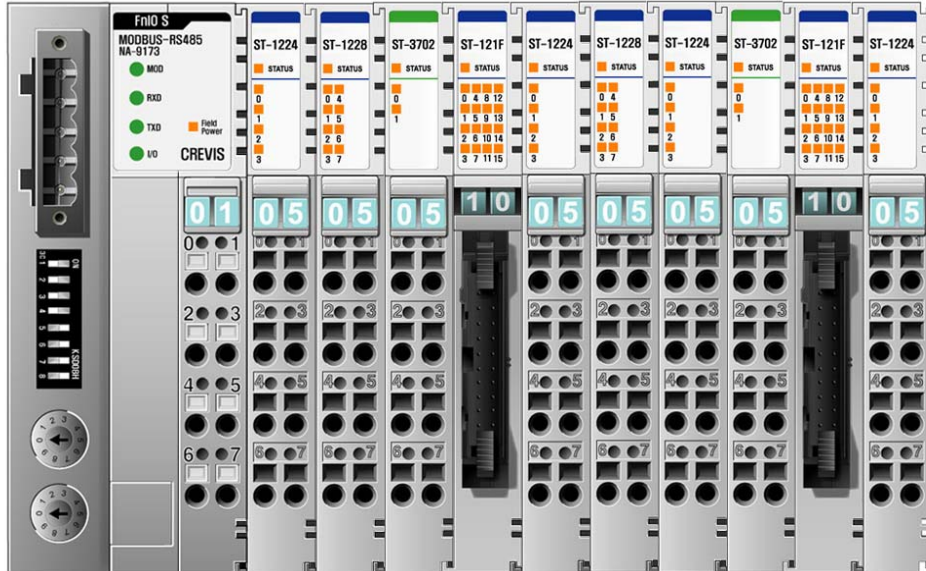
◆ Bit Map

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*16.
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*16

◆ 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 point 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.

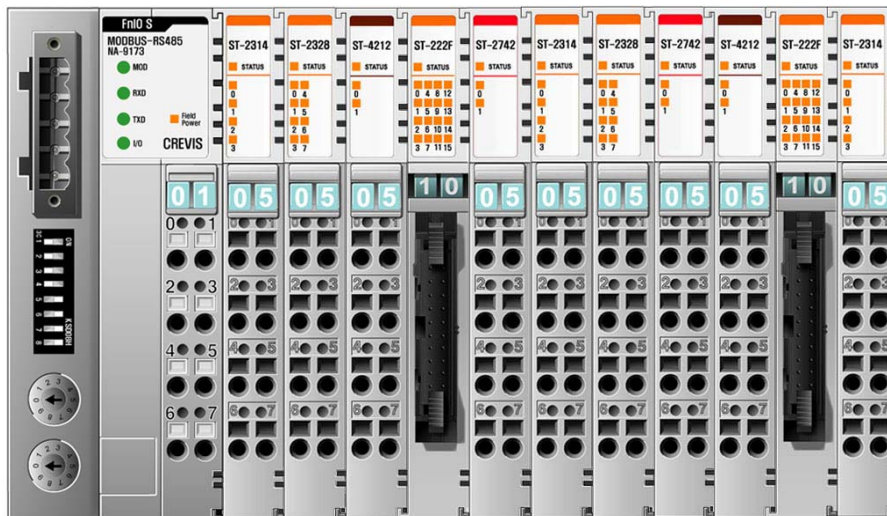
*Size of input image bit is size of input image register

● 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 do 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 Registers	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 RS485 Network Set up is like following figure1.

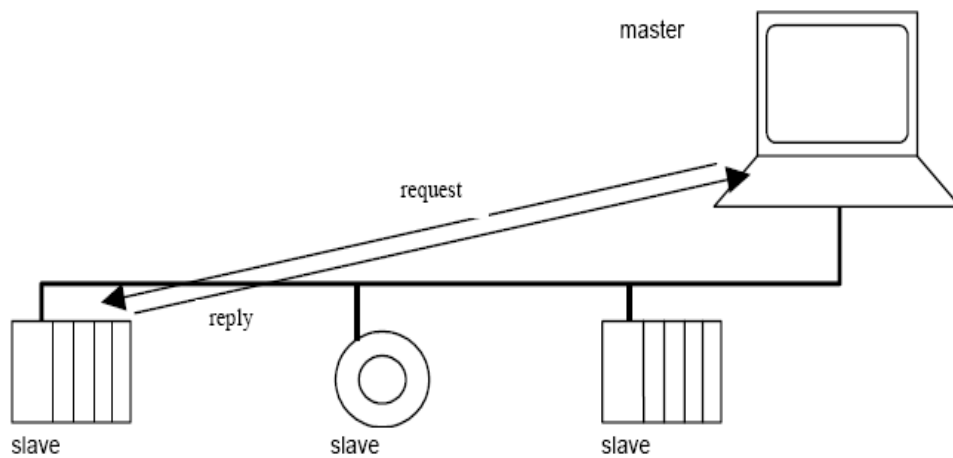


Figure 1 MODBUS Network

1) RS485-MODBUS Electrical Interface

RS485 Connector

RS485+	—
RS485-	—
GND	—
Shield	—
FG	—



Figure 2 RS485 MODBUS Interface

5 pin connector	Signal Name	Description
-----------------	-------------	-------------

1	RXD/TXD+	In/Out, Transceiver Data High
2	RXD/TXD-	In/Out, Transceiver Data Low
3	GND	Signal Common
4	Shield	Shield
5	FG	Frame Ground Internally Shorted with Shield

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, 57600bps, 115.2kbps.

4) Maximum number of device without repeater

A figure of 32 device is always authorized on any RS485-MODBUS system without repeater.

Depending of :

- all the possible addresses.
- the figure of RS485 Unit Load used by the device.
- and the line polarization in need be.

RS485 system may implement a larger number of devices. Some devices allow the implementation of a RS485-MODBUS serial line with more than 32 devices, without repeater. In this case these MODBUS devices must be documented to say how many of such devices are authorized without repeater. The use of a repeater between two heavy loaded RS485-MODBUS is also possible.

5) Length

The end to end length of trunk cable must be limited. The maximum length depends on the baudrate, the cable, the number of loads on the daisy chain, and the network configuration For a maximum 9600 Baudrate and AWG26 gauge, the maximum length is 1200m.

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
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Not Powered No Expansion Module	Off	Device has no expansion module or may not be 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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