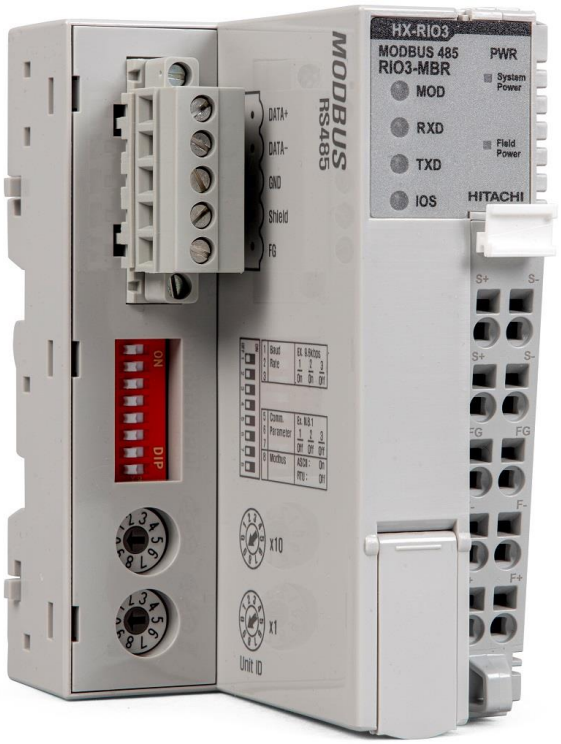
# MODBUS RTU Network Adapter

# RIO3-MBR
# User Manual

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| DOCUMENT CHANGE SUMMARY | | | | |
|---|---|---|---|---|
| REV | PAGE | REMARKS | DATE | EDITOR |
| 1.02 | | | March 21 | Faber |
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# Content

# 1. Important Note

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 satisfy themselves that each intended application of this equipment is acceptable. In no event will HITACHI 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, HITACHI cannot assume responsibility or liability for actual use based on the examples and diagrams.

**Warning!**

✓ **If you don't follow the directions, it could cause a personal injury, damage to the equipment or explosion**

- Do not assemble the products and wire with power applied to the system. Else it may cause an electric arc, which can result into unexpected and potentially dangerous action by field devices. Arching is explosion risk in hazardous locations. Be sure that the area is non-hazardous or remove system power appropriately before assembling or wiring the modules.
- Do not touch any terminal blocks or IO modules when system is running. Else it may cause the unit to an electric shock or malfunction.
- Keep away from the strange metallic materials not related to the unit and wiring works should be controlled by the electric expert engineer. Else it may cause the unit to a fire, electric shock or malfunction.

**Caution!**

✓ **If you disobey the instructions, there may be possibility of personal injury, damage to equipment or explosion. Please follow below Instructions.**

- Check the rated voltage and terminal array before wiring. Avoid the circumstances over 55℃ of temperature. Avoid placing it directly in the sunlight.
- Avoid the place under circumstances over 85% of humidity.
- Do not place Modules near by the inflammable material. Else it may cause a fire.
- Do not permit any vibration approaching it directly.
- Go through module specification carefully, ensure inputs, output connections are made with the specifications. Use standard cables for wiring.
- Use Product under pollution degree 2 environment.

## 1.1. Safety Instruction

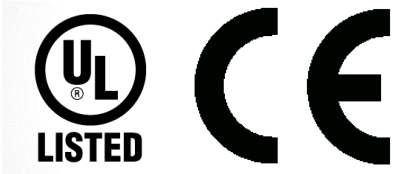
### 1.1.1. Symbols

| | |
|---|---|
| DANGER  | identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death property damage, or economic loss. |
| IMPORTANT | Identifies information that is critical for successful application and understanding of the Product. |
| ATTENTION  | Identifies information about practices or circumstances that can lead to personal injury, property damage, or economic loss. Attentions help you to identity a hazard, avoid a hazard, and recognize the consequences. |

### 1.1.2. Safety Notes

| | |
|---|---|
| DANGER  | 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, e.g. G-BUS Pin. |

### 1.1.3. Certification



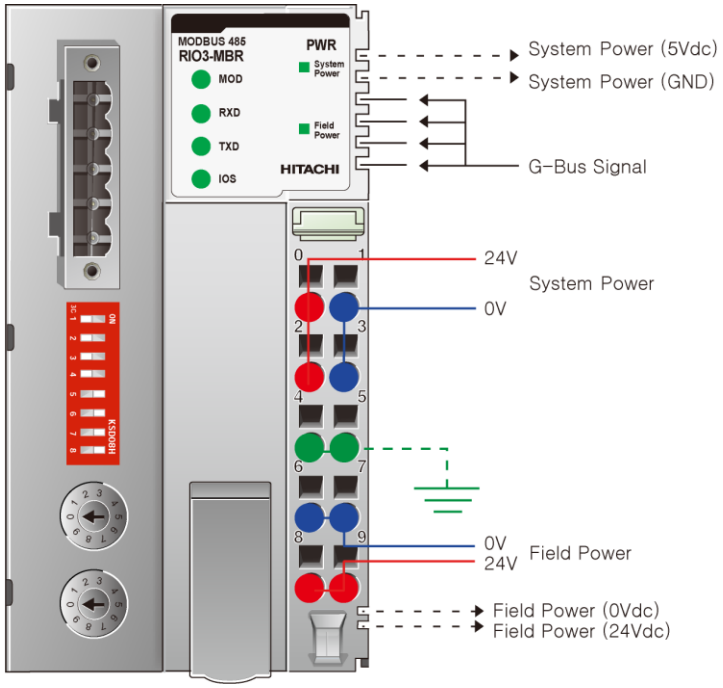
# 2. Specification

## 2.1. The Interface

### 2.1.1. RIO3-MBR

RS485 Connector


| Dsub 5-Pin (Female) | SignalName | Description |
|---|---|---|
| 1 | RS485+ | In/Out, Transceiver Data High |
| 2 | RS485- | In/Out, Transceiver Data Low |
| 3 | GND | Signal Common |
| 4 | Shield | Shield |
| 5 | FG | Frame Ground.<br>Internally shorted with Shield |




| Pin No. | Signal Description | Signal Description | Pin No. |
|---|---|---|---|
| 0 | System Power, 24V | System Power, Ground | 1 |
| 2 | System Power, 24V | System Power, Ground | 3 |
| 4 | F.G | F.G | 5 |
| 6 | Field Power, Ground | Field Power, Ground | 7 |
| 8 | Field Power, 24V | Field Power, 24V | 9 |

## 2.2.Specification

### 2.2.1. General Specification

| General specification | |
|---|---|
| UL System Power | Supply voltage : 24Vdc nominal, Class 2 |
| System Power | Supply voltage : 24Vdc nominal<br>Supply voltage range : 15~30Vdc<br>Protection : Output current limit (Min. 1.5A)<br>Reverse polarity protection |
| Power Dissipation | 70mA typical @ 24Vdc |
| Current for I/O Module | 1.5A @ 5Vdc |
| Isolation | System power to internal logic : Non-isolation<br>System power I/O driver : Isolation |
| UL Field Power | Supply voltage : 24Vdc nominal, Class 2 |
| Field Power | Supply voltage : 24Vdc typical (Max. 30Vdc)<br>* Field Power Range is different depending on IO Module series.<br>Refer to IO Module`s Specification. |
| Max. Current Field Power Contact | DC 10A Max |
| Wiring | I/O Cable Max. 2.0㎟(AWG14) |
| Torque | 0.8Nm(7 lb-in) |
| Weight | 162g |
| Module Size | 54mm x 99mm x 70mm |

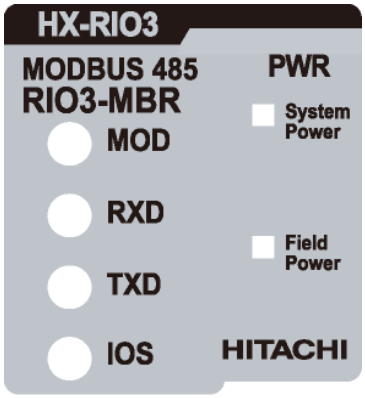
| Environmental specification | |
|---|---|
| Operating Temperature | -40℃~70℃ |
| UL Temperature | -20℃~60℃ |
| Storage Temperature | -40℃~85℃ |
| Relative Humidity | 5% ~ 90% non-condensing |
| Mounting | DIN rail |

## 2.2.2. Interface Specification

| Interface Specification RIO3-MBR(RS-485) | |
|---|---|
| Adapter Type | Slave node (MODBUS Serial RTU/ASCII Server) |
| Protocol | MODBUS RTU and ASCII |
| Max. Expansion Module | 63 slots |
| Max. Data Size(Input + Output) | Max 128 bytes each slot |
| Max Length Bus Line | 1200m |
| Max. Nodes | 99 nodes |
| Baud Rate | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps |
| Interface Connector | 5 Pin open connector |
| Settable Node Address | 1 ~ 99 with two rotary switches |
| Serial Port | RS232 for MODBUS/RTU, Touch Panel or IO-Guide |
| Serial Configuration (RS232) | Node : 1 (Fixed)<br>Baud Rate : 115200 (Fixed)<br>Data bit : 8 (Fixed)<br>Parity bit : No parity (Fixed)<br>Stop bit : 1 (Fixed) |
| Indicator | 6 LED<br>1 Green/Red, Module Status (MOD)<br>1 Green, Receive Data (RXD)<br>1 Green, Transmit Data (TXD)<br>1 Green/Red, Expansion I/O Module Status (IOS)<br>1 Green, System Power Status<br>1 Green, Field Power Status |
| Module Location | Starter module left side of HX-RIO3 system |
| Field Power Detection | About 14Vdc |

| General specification | |
|---|---|
| Shock Operating | IEC 60068-2-27 |
| Vibration Resistance | Based on IEC 60068-2-6 |
| Industrial Emissions | EN 61000-6-4/A11 : 2011 |
| Industrial Immunity | EN 61000-6-2 : 2005 |
| Installation Position | vertical and horizontal installation is available |
| Product Certifications | CE, UL, EAC |

## 2.3. LED Indicator




| LED No. | LED Function / Description | LED Color |
|---|---|---|
| MOD | Module Status | Green/Red |
| RXD | Receive Data | Green |
| TXD | Transmit Data | Green |
| IOS | Expansion Module Status | Green/Red |
| System Power | System Power Enable | Green |
| Field Power | Field Power Enable | Green |

### 2.3.1. MOD (Module Status LED)

| Status | LED | To indicate |
|---|---|---|
| Not Powered | OFF | Power is not supplied to the unit. |
| Device Operational | Green | The unit is operating in normal condition. |
| Unrecoverable Fault | Red | The device has an unrecoverable fault.<br>- Memory error or CPU watchdog error. |

### 2.3.2. RXD (Receive Data LED)

| Status | LED | To indicate |
|---|---|---|
| Not Powered or Not Linked | OFF | Device is idle or may not be powered. |
| Adapter received correct message frame | Green | Adapter(Slave) received correct frame which address to the slave or broadcast. About 20msec flashing |

### 2.3.3 TXD (Transmit Data LED)

| Status | LED | To indicate |
|---|---|---|
| Not Powered | OFF | Device is idle or may not be powered. |
| Adapter transmit frame | Flashing Green | Adapter(slave) transmit frame. About 20msec flashing. |

## 2.3.4. IOS LED (Extension Module Status LED)

| Status | LED | To indicate |
|---|---|---|
| Not Powered | OFF | Device may not be powered. |
| No Expansion Module | Flashing Red | Adapter has no expansion module |
| Internal Bus Connection, Run Exchanging I/O | Green | Exchanging I/O data. |
| Expansion Configuration Failed | Red | One or more expansion module occurred in fault state.<br>- Detected invalid expansion module ID.<br>- Overflowed Input/Output Size<br>- Too many expansion module<br>- Initialization failure<br>- Communication failure.<br>- Changed expansion module configuration.<br>- Mismatch vendor code between adapter and expansion module. |

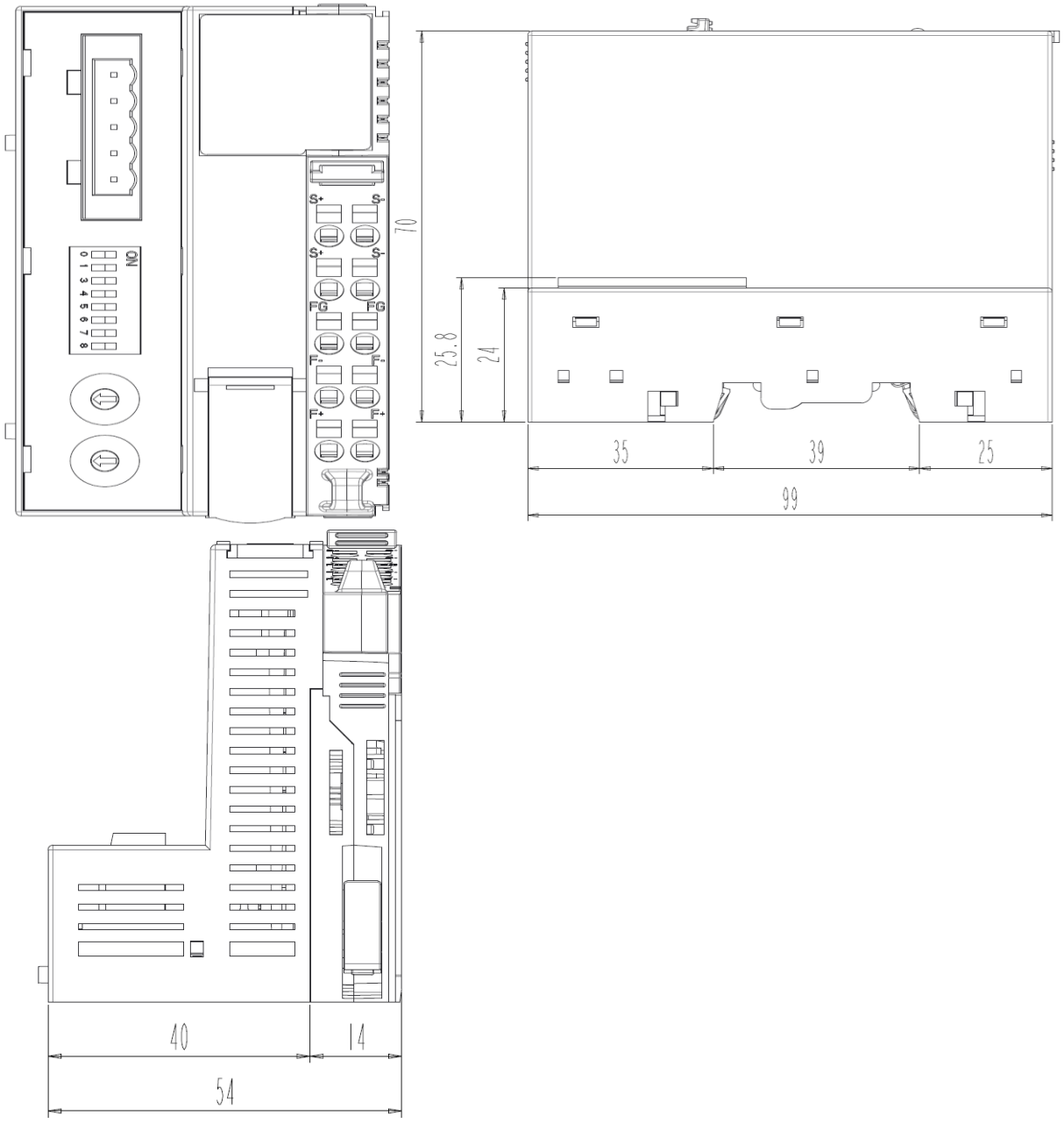
## 2.3.5. Field-, System Power LED (Field-, System Power Status LED)

| Status | LED | To indicate |
|---|---|---|
| No field, System power | OFF | Not supplied 24Vdc field power, 5Vdc system power. |
| Supplied field, System power | Green | Supplied 24Vdc field power, 5Vdc system power. |

# 3.Dimension

## 3.1. RIO3-MBR

(mm)



# 4. Mechanical Set Up

## 4.1. Total Expansion

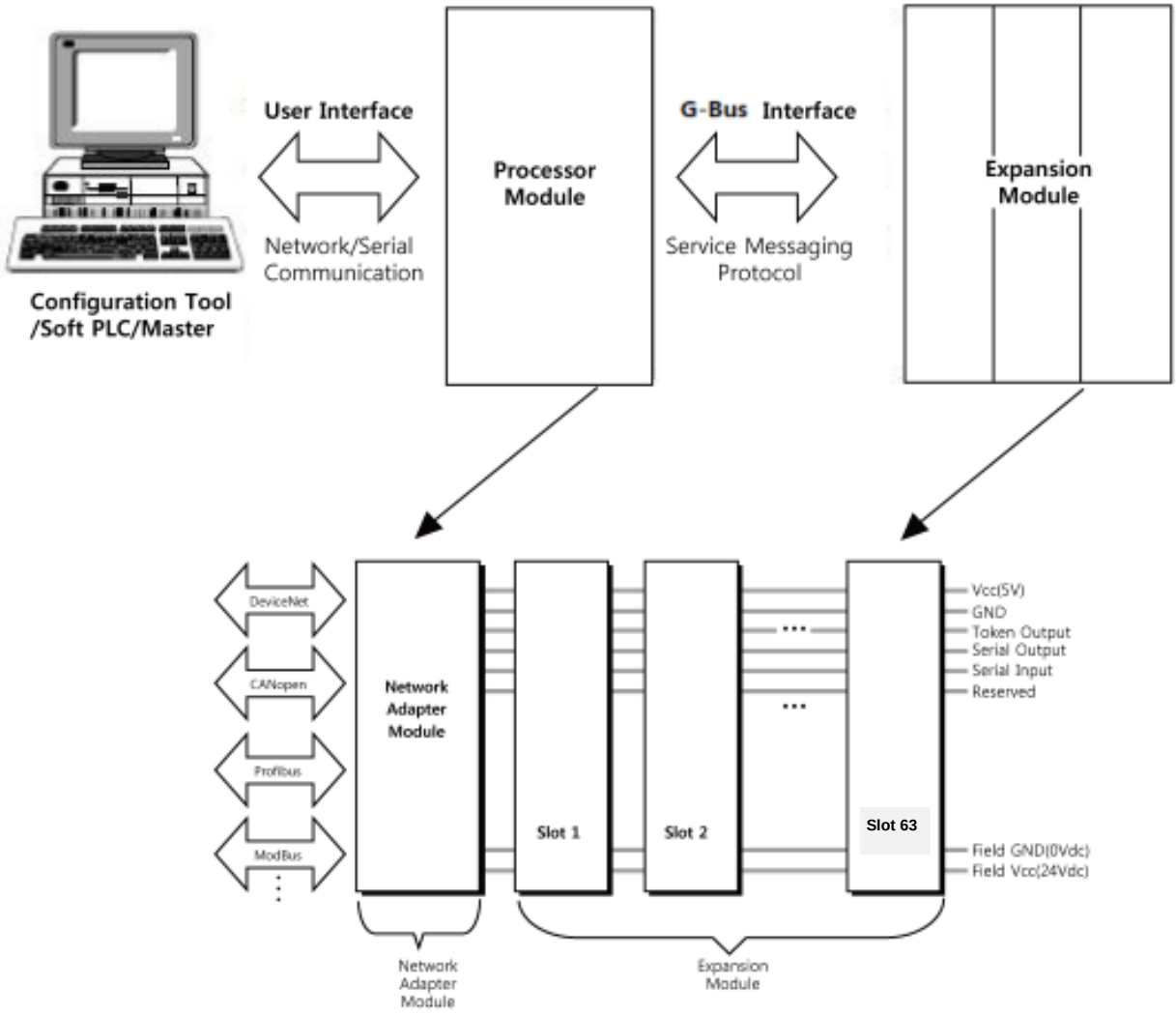
The number of the module assembly that can be connected is 32. The maximum length is 426mm Exception.

## 4.2. Plugging and Removal of the Components.


As above figure in order to safeguard the RIO3 module from jamming, it should be fixed onto the DIN rail with locking level. To do so, fold on the upper of the locking lever. To pull out the RIO3 module, unfold the locking lever as below figure.

| | |
|---|---|
| DANGER  | Before work is done on the components, the voltage supply must be turned off. |

# 5. MODBUS Electrical Interface



## 5.1. G-Bus System

- **Network Adapter Module**

  The Network Adapter Module forms the link between the field bus and the field devices with the Expansion Modules.

  The connection to different field bus systems can be established by each of the corresponding Network Adapter Module, e.g. for SyncNet, PROFIBUS, CANopen, DeviceNet , Ethernet/IP, CC-Link, MODBUS/Serial, MODBUS/TCP etc.

- **Expansion Module**

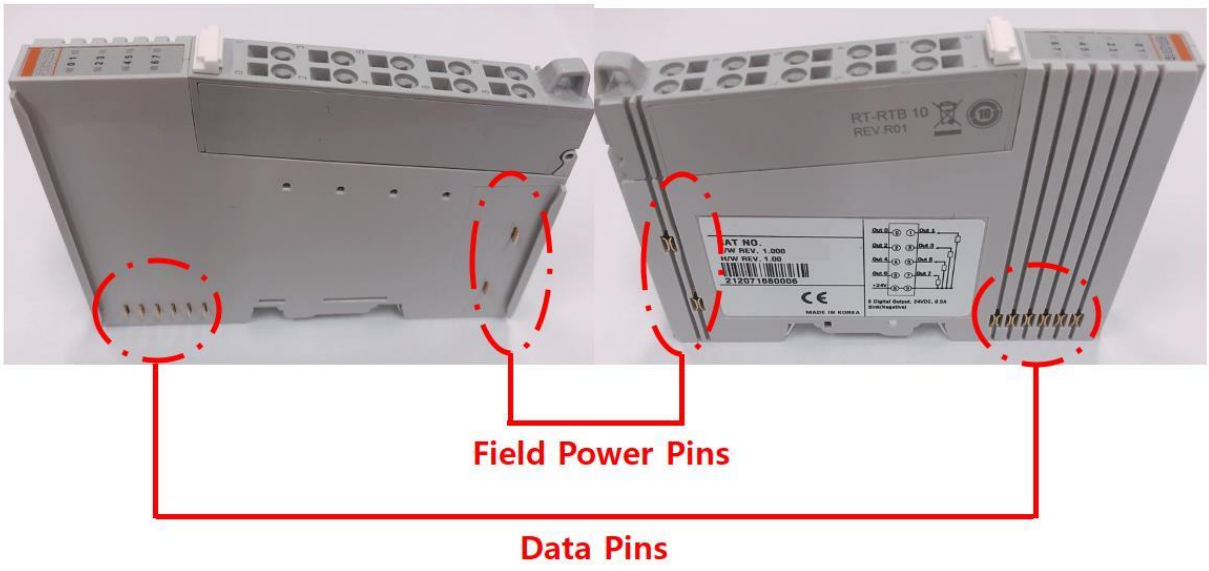
  The Expansion Modules are supported a variety of input and output field devices.
  There are digital and analog input/output modules and special function modules.

- **Two types of G-Bus Message**

  - Service Messaging
  - I/O Messaging

## 5.2. G-Bus Pin Description

Communication between the RIO3 series and the expansion 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 pin and 2 field power pin.

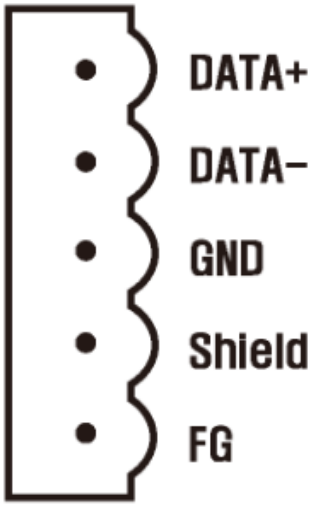



| No. | Name | Description |
|---|---|---|
| 1 | Vcc | System supply voltage (5V dc). |
| 2 | GND | System Ground. |
| 3 | Token Output | Token output port of Processor module. |
| 4 | Serial Output | Transmitter output port of Processor module. |
| 5 | Serial Input | Receiver input port of Processor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

| DANGER | |
|---|---|
|  | Do not touch data and field power pins in order to avoid soiling and damage by ESD noise. |

## 5.3. RIO3-MBR Electrical Interface

### 5.3.1. 5pin open connector

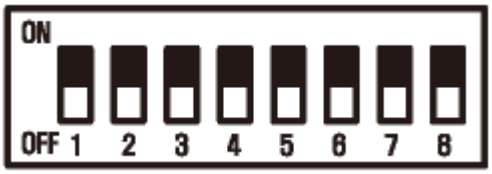



| 5 Pin Open Connector | Signal Name | Description |
|---|---|---|
| 1 | RS485+ | In/Out, Transceiver Data High |
| 2 | RS485- | In/Out, Transceiver Data Low |
| 3 | GND | Signal Common |
| 4 | Shield | Shield |
| 5 | FG | Frame Ground.<br>Internally shorted with Shield |

- 3986-90102/Molex or 1862506/Phoenix, Compatible with DeviceNet 5-pin Open Connector

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

## 5.3.2. MODBUS Dip Switch Setup




| 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 | | | | | |
| Byte Format | 8bit, No Parity, 1Stop | | | | | OFF | OFF | OFF | |
| | 8bit, Even Parity, 1Stop | | | | | ON | OFF | OFF | |
| | 8bit, Odd Parity, 1Stop | | | | | OFF | ON | OFF | |
| | 8bit, No Parity, 2Stop | | | | | ON | ON | OFF | |
| | 7bit, Even Parity, 1Stop * | | | | | ON | OFF | ON | |
| | 7bit, Odd Parity, 1Stop * | | | | | OFF | ON | ON | |
| | 8bit, No Parity, 1Stop | | | | | ON | ON | ON | |
| RTU/ASCII Mode | RTU Mode | | | | | | | | OFF |
| | ASCII Mode | | | | | | | | ON |

* ASCII Mode is only available
** It is recommended to set the baudrate to 9600bps above when set the parameter using IO Guide Pro.

## 5.3.3. MODBUS Address Setup

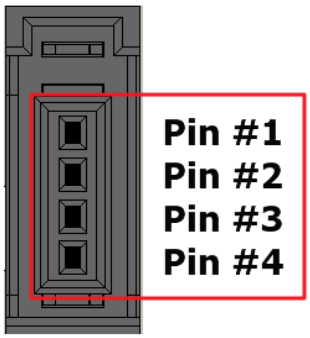


Each MODBUS Adapter could have an unique address (from 1 to 99) so that it can be addressed independently from other nodes.
The address 0 is reserved to identify a broadcast exchange.
No response is returned to broadcast requests sent by the master.

**ATTENTION**

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

## 5.3.4. RS232 Port for MODBUS/RTU, Touch Panel or IO-Guide



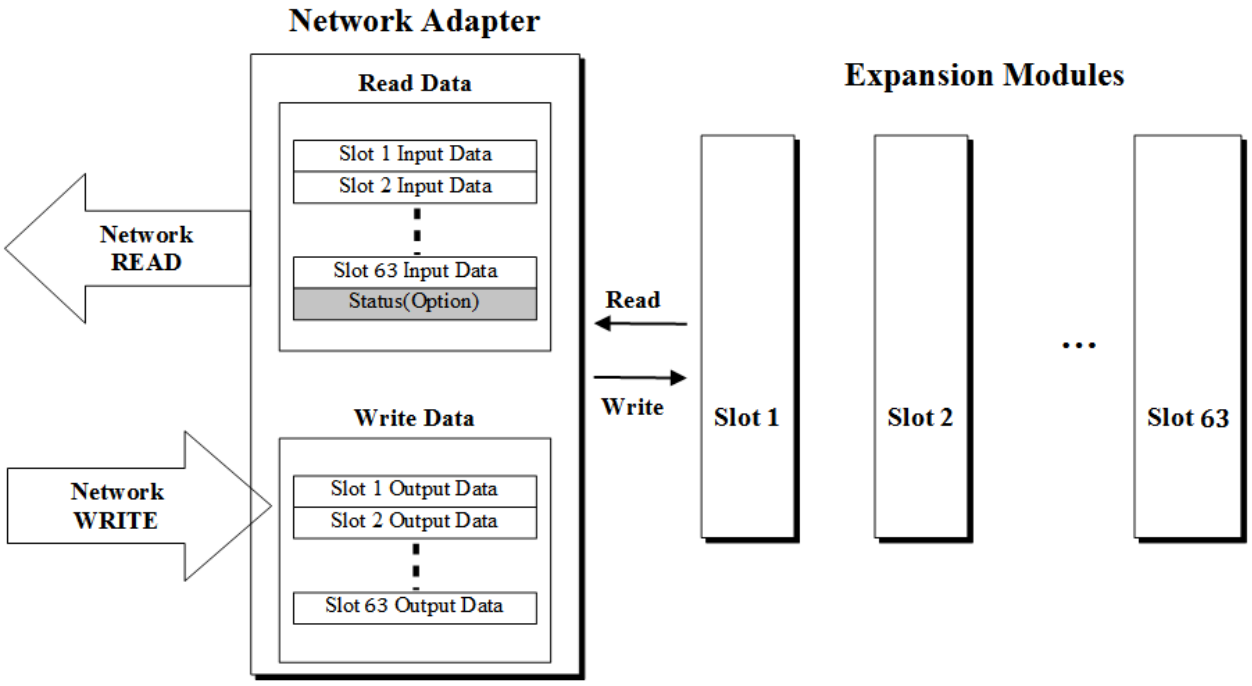

| Pin# | Signal Name | Description |
|---|---|---|
| 1 | Reserved | ---- |
| 2 | TXD | RS232 TXD |
| 3 | RXD | RS232 RXD |
| 4 | GND | RS232 GND |

**ATTENTION**

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

## 5.3.5. Process Image Map

An expansion module may have 3 types of data as I/O data, configuration parameter and memory register.
The data exchange between Network Adapter and expansion modules is done via an I/O process image data by HX-RIO3 protocol. The following figure shows the data flow of process image between Network Adapter and expansion modules.




## 5.3.6. MODBUS Interface Register/Bit Map

**• Register Map**

| Start Address | Read/Write | Description | Func. Code |
|---|---|---|---|
| 0x0000 ~ | Read | Process input image registers (Real Input Register) | 3,4,23 |
| 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 | Expansion Slot Information special registers. | 3,4,6,16,23 |

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

**• Register Map**

| Start Address | Read/Write | Description | Func. Code |
|---|---|---|---|
| 0x0000~ | Read | Process input image bits<br>All input registers areas are addressable by bit address.<br>Size of input image bit is size of input image register * 16. | 2 |
| 0x1000~ | Read/Write | Process output image bits<br>All output registers areas are addressable by bit address.<br>Size of output image bit is size of output image register * 16. | 1,5,15 |

## 5.4. Example

### 5.4.1. Example of Input Process Image (Input Register) Map

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. Input process image mode can be set by special register 0x1114(4372). Refer to 6.3.3.

Example slot configuration

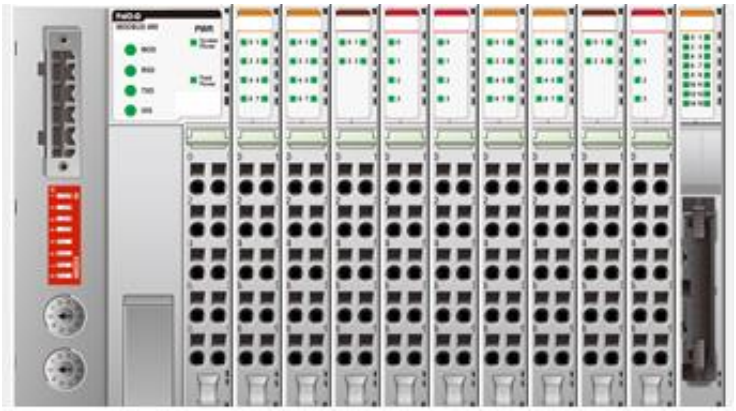
| Slot Address | Module Description |
|---|---|
| #0 | MODBUS RS485 Adapter |
| #1 | 8-discrete input |
| #2 | 8-discrete input |
| #3 | 4-analog input |
| #4 | 16-discrete input |
| #5 | 8-discrete input |
| #6 | 8-discrete input |
| #7 | 8-discrete input |
| #8 | 16-discrete input |
| #9 | 8-discrete input |

| Address | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0x0001 | Discrete Input 8 pts (Slot#2) | | | | | | | | Discrete Input 8 pts (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 | Analog Input Ch2 high byte (Slot#3) | | | | | | | | Analog Input Ch2 low byte (Slot#3) | | | | | | | |
| 0x0005 | Analog Input Ch3 high byte (Slot#3) | | | | | | | | Analog Input Ch3 low byte (Slot#3) | | | | | | | |
| 0x0006 | Discrete Input 8 pts (Slot#4) | | | | | | | | Discrete Input 8 pts (Slot#4) | | | | | | | |
| 0x0007 | Discrete Input 8 pts (Slot#6) | | | | | | | | Discrete Input 8 pts (Slot#5) | | | | | | | |
| 0x0008 | Discrete Input 8 pts (Slot#8) | | | | | | | | Discrete Input 8 pts (Slot#7) | | | | | | | |
| 0x0009 | Discrete Input 8 pts (Slot#9) | | | | | | | | Discrete Input 8 pts (Slot#8) | | | | | | | |

## 5.4.2. Example of Output Process Image (Output Register) Map

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. Output process image mode can be set by special register 0x1115(4373). Refer to 6.3.3.

Example slot configuration



| Slot Address | Module Description |
|---|---|
| #0 | MODBUS RS485 Adapter |
| #1 | 8-discrete output |
| #2 | 8-discrete output |
| #3 | 4-analog output |
| #4 | 4-relay output |
| #5 | 4-relay output |
| #6 | 8-discrete output |
| #7 | 8-discrete output |
| #8 | 4-analog output |
| #9 | 4-relay output |
| #10 | 16-discrete output |

| Address | B15 | B14 | B13 | B12 | B11 | B10 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0x0800 | Discrete Output 8 pts (Slot#2) | | | | | | | | Discrete Input 8 pts (Slot#1) | | | | | | | |
| 0x0801 | Analog Output Ch0 high byte (Slot#3) | | | | | | | | Analog Input Ch0 low byte (Slot#3) | | | | | | | |
| 0x0802 | Analog Output Ch1 high byte (Slot#3) | | | | | | | | Analog Input Ch1 low byte (Slot#3) | | | | | | | |
| 0x0803 | Analog Output Ch2 high byte (Slot#3) | | | | | | | | Analog Input Ch2 low byte (Slot#3) | | | | | | | |
| 0x0804 | Analog Output Ch3 high byte (Slot#3) | | | | | | | | Analog Input Ch3 low byte (Slot#3) | | | | | | | |
| 0x0805 | Empty, Don't Care | | | | Discrete Out 4 pts (Slot#5) | | | | Empty, Don't Care | | | | Discrete Out 4 pts (Slot#4) | | | |
| 0x0806 | Discrete Output low 8 pts (Slot#7) | | | | | | | | Discrete Output low 8 pts (Slot#6) | | | | | | | |
| 0x0807 | Analog Output Ch0 high byte (Slot#8) | | | | | | | | Analog Output Ch0 low byte (Slot#8) | | | | | | | |
| 0x0808 | Analog Output Ch1 high byte (Slot#8) | | | | | | | | Analog Output Ch1 low byte (Slot#8) | | | | | | | |
| 0x0809 | Analog Output Ch2 high byte (Slot#8) | | | | | | | | Analog Output Ch2 low byte (Slot#8) | | | | | | | |
| 0x080A | Analog Output Ch3 high byte (Slot#8) | | | | | | | | Analog Output Ch3 low byte (Slot#8) | | | | | | | |
| 0x080B | Discrete Output low 8 pts (Slot#10) | | | | | | | | Empty, Don't Care | | | | Discrete Out 4 pts (Slot#9) | | | |
| 0x080C | Empty, Don't Care | | | | | | | | Discrete Output high 8 pts (Slot#10) | | | | | | | |

# 6. MODBUS INTERFACE

## 6.1. MODBUS Interface Register/Bit Map

- **Register Map**

| Start Address | Read/Write | Description | Func. Code |
|---|---|---|---|
| 0x0000 ~ | Read | Process input image registers (Real Input Register) | 3,4,23 |
| 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 | Expansion Slot Information special registers | 3,4,6,16,23 |

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

- **Register Map**

| Start Address | Read/Write | Description | Func. Code |
|---|---|---|---|
| 0x0000 ~ | Read | Process input image bits<br>All input registers areas are addressable by bit address.<br>Size of input image bit is size of input image register * 16. | 2 |
| 0x1000 ~ | Read/Write | Process output image bits<br>All output registers areas are addressable by bit address.<br>Size of output image bit is size of output image register * 16. | 1,5,15 |

## 6.2. Supported MODBUS Function Codes

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

- Refer to MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1a

## 6.3. MODBUS Transmission Mode

Two different serial transmission modes are defined : The RTU mode 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.

### 6.3.1. 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 baud rate. 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 chars(s) | 2 chars | ≥ 3.5 char |

### 6.3.2. 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 does not allow the conformance with RTU mode requirements regarding timers management.

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

### 6.3.3. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | - | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| 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 | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| Error Check (CRC/LRC) | - | 0x31, 0x44 | "7C" | 0x37, 0x43 |
| End of Frame | - | t1-t2-t3 | CR, LF | 0x0D, 0x0A |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Output Status | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Output Status | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Error Check (CRC/LRC) | --- | 0x40, 0x34 | "9A" | 0x39, 0x41 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0x0A |

## 6.3.4. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "07" | 0x36, 0x33 |
| 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 | 0x10 | 0x10 | "0A" | 0x31, 0x30 |
| Error Check (CRC/LRC) | --- | 0x71, 0x84 | "ED" | 0x38, 0x42 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Input Status | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Input Status | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Error Check (CRC/LRC) | --- | 0x40, 0x70 | "99" | 0x39, 0x39 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

## 6.3.5. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x03 | 0x03 | "03" | 0x30, 0x33 |
| Starting Address Hi | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| Starting Address Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Quantity of Register Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Quantity of Register Lo | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| Error Check (CRC/LRC) | --- | 0x88, 0x88 | "89" | 0x38, 0x39 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0x0A |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x03 | 0x03 | "03" | 0x30, 0x33 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Output Register#0 Hi | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Output Register#0 Lo | 0xE5 | 0xE5 | "E5" | 0x45, 0x35 |
| Error Check (CRC/LRC) | --- | 0x81, 0x67 | "B1" | 0x42, 0x31 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0x0A |

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

## 6.3.6. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x04 | 0x04 | "04" | 0x30, 0x34 |
| Starting Address Hi | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| Starting Address Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Quantity of Register Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Quantity of Register Lo | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| Error Check (CRC/LRC) | --- | 0x3D, 0x48 | "88" | 0x38, 0x38 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0x0A |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x04 | 0x04 | "04" | 0x30, 0x34 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Input Register#0 Hi | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Input Register#0 Lo | 0xE5 | 0xE5 | "E5" | 0x45, 0x35 |
| Error Check (CRC/LRC) | --- | 0x80, 0x13 | "B0" | 0x42, 0x30 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

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

## 6.3.7. 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 state 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "36" | 0x36, 0x33 |
| Function Code | 0x05 | 0x05 | "05" | 0x30, 0x35 |
| Output Address Hi | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| Output Address Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Output Value Hi | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| Output Value Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Error Check (CRC/LRC) | --- | 0x80, 0xB8 | "8Y" | 0x38, 0x59 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "36" | 0x36, 0x33 |
| Function Code | 0x05 | 0x05 | "05" | 0x30, 0x35 |
| Output Address Hi | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| Output Address Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Output Value Hi | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| Output Value Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Error Check (CRC/LRC) | --- | 0x80, 0xB8 | "8Y" | 0x38, 0x59 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

- Output bit of address 0x1001 turns ON.

## 6.3.8. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x06 | 0x06 | "06" | 0x30, 0x36 |
| Register Address Hi | 0x08 | 0x08 | "08" | 0x30, 0x38 |
| Register Address Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Register Value Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Register Value Lo | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| Error Check (CRC/LRC) | --- | 0xC3, 0xA8 | "90" | 0x39, 0x30 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x06 | 0x06 | "06" | 0x30, 0x36 |
| Register Address Hi | 0x08 | 0x08 | "08" | 0x30, 0x38 |
| Register Address Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Register Value Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Register Value Lo | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| Error Check (CRC/LRC) | --- | 0xC3, 0xA8 | "90" | 0x39, 0x30 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

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

## 6.3.9. 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.

**•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 | 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 |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| 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 |

**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.

| 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.
Especially, data field 0x55AA make the remote device to restart with factory default setup of EEPROM.

| Sub-function | Data Field (Request) | Data Field (Response) | Description |
|---|---|---|---|
| 0x0001(1) | 0x0000 or 0xFF00 | Echo Request Data | Reset |
| 0x0001(1) | 0x55AA+0xAB7B+Sumcheck | Echo Request Data | Reset with Factory default [1)] |
| 0x0001(1) | 0x55AA+0xAA55+Sumcheck | Echo Request Data | Reset with Factory default [2)] |

1),2) IP Address, Subnet Mask Address, Gateway Address will be the factory defaults value.
2) Mac Address will be the factory default value.

**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.

| 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.

| 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.

| 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 3.2.11.

| 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.

| 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.

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

**Sub-function 0x0064(100) Return Slave ModBus, Internal Bus Status**

The response data field returns the status of ModBus and Internal Bus addressed to the remote device.
This status values are identical with status 1word of input process image.

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

**Sub-function 0x0065(101) Return Slave Watchdog 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.

| Sub-function | Data Field (Request) | Data Field (Response) | Description |
|---|---|---|---|
| 0x0065(101) | 0x0000 | Watchdog Error Count | |

## 6.3.10. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| 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 | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Output Value#0 | 0x0F | 0x0F | "0F" | 0x30, 0x46 |
| Output Value#1 | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Error Check (CRC/LRC) | --- | 0x47, 0x73 | "5D" | 0x35, 0x44 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| 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 | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| Error Check (CRC/LRC) | --- | 0x58, 0x85 | "6E" | 0x36, 0x45 |
| 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.

## 6.3.11. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| 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 | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Register Value#0 Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Register Value#0 Lo | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| Error Check (CRC/LRC) | --- | 0xDE, 0xB2 | "83" | 0x38, 0x33 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0xA |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x10 | 0x10 | "10" | 0x31, 0x30 |
| 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 | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| Error Check (CRC/LRC) | --- | 0x0B, 0xEB | "84" | 0x38, 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.

## 6.3.12. 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.

**•Request**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x17 | 0x17 | "17" | 0x31, 0x37 |
| Read Starting Address Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Read Starting Address Lo | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Quantity of Read Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Quantity of Read Lo | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| 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 | 0x01 | 0x01 | "01" | 0x30, 0x31 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Write Reg. Value#0 Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Write Reg. Value#0 Lo | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| Error Check (CRC/LRC) | --- | 0x1B, 0xCC | "7B" | 0x37, 0x42 |
| End of Frame | --- | t1-t2-t3 | CR, LF | 0x0D, 0x0A |

**•Response**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| Start of Frame | --- | t1-t2-t3 | ":" | 0x3A |
| Slave Address | 0x63 | 0x63 | "63" | 0x36, 0x33 |
| Function Code | 0x17 | 0x17 | "17" | 0x31, 0x37 |
| Byte Count | 0x02 | 0x02 | "02" | 0x30, 0x32 |
| Read Reg. Value#0 Hi | 0x00 | 0x00 | "00" | 0x30, 0x30 |
| Read Reg. Value#0 Lo | 0xFF | 0xFF | "FF" | 0x46, 0x46 |
| Error Check (CRC/LRC) | --- | 0x04, 0x3C | "85" | 0x38, 0x35 |
| 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.

## 6.3.13. 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.

**•Exception Response Example**

| Field name | Example | RTU | ASCII | ASCII (bus line) |
|---|---|---|---|---|
| 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 |

**•Exception Codes**

| Exception Code | Name | Description |
|---|---|---|
| 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.<br>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. |

- RIO3-MBR response exception code 01, 02, 03, 04 and 06.

## 6.4. 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 each address (one address).

### 6.4.1 Adapter Identification Special Register (0x1000, 4096)

| Address | Access | Type, Size | Description |
|---|---|---|---|
| 0x1000(4096) | Read | 1word | Vendor ID = 0x02E5(741), Hitachi Ltd. |
| 0x1001(4097) | Read | 1word | Device type = 0x000C, Network Adapter |
| 0x1002(4098) | Read | 1word | Product Code = 0x9030 |
| 0x1003(4099) | Read | 1word | Firmware revision, if 0x0101, revision 1.01 |
| 0x1004(4100) | Read | 2word | Product unique serial number |
| 0x1005(4101) | Read | String<br>Up to 34byte | Product name string (ASCII)<br>“RIO3-MBR,Modbus/485,HX-RIO3” |
| 0x1006(4102) | Read | 1word | Sum check of EEPROM |
| 0x1010(4112) | Read | 2word | Firmware release date |
| 0x1011(4113) | Read | 2word | Product manufacturing inspection date |
| 0x101E(4126) | Read | 7word<br>- 1word<br>- 1word<br>- 1word<br>- 1word<br>- 1word<br>- 2word | Composite Id of following address<br>* RTU mode<br>0x1100(4352), Modbus RS232 Node. (Fixed 0x0001)<br>0x1000(4096), Vendor ID<br>0x1001(4097), Device type<br>0x1002(4098), Product code<br>0x1003(4099), Firmware revision<br>0x1004(4100), Product serial number |

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

### 6.4.2. 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.

| Address | Access | Type, Size | Description |
|---|---|---|---|
| 0x1020(4128) | Read/Write | 1word | Watchdog time value 16bits unsigned.<br>The time value is represented by multiples of 100msec.<br>The 0 (watchdog timeout disabled) is default value.<br>A changing of watchdog time value resets watchdog error and counter. |
| 0x1021(4129) | Read | 1word | Watchdog timer remain value<br>This value is decreased every 100msec |
| 0x1022(4130) | Read | 1word | Watchdog error counter, it is cleared by writing address 0x1020 |
| 0x1023(4131) | Read/Write | 1word | Enable/disable auto recovery Watchdog error when receiving new frame.<br>0:Disable, 1:Enable(default). Its value is stored in EEPROM. |
| 0x1028(4136) | Read | 1word | IO update time, main loop time. (1usec unit) |

## 6.4.3. Adapter Information Special Register (0x1100, 4352)

<table>
<tr><th>Address</th><th>Access</th><th>Type, Size</th><th>Description</th></tr>
<tr><td>0x1102(4354)</td><td>Read</td><td>1word</td><td>Start address of input image word register. =0x0000</td></tr>
<tr><td>0x1103(4355)</td><td>Read</td><td>1word</td><td>Start address of output image word register. =0x0800</td></tr>
<tr><td>0x1104(4356)</td><td>Read</td><td>1word</td><td>Size of input image word register.</td></tr>
<tr><td>0x1105(4357)</td><td>Read</td><td>1word</td><td>Size of output image word register.</td></tr>
<tr><td>0x1106(4358)</td><td>Read</td><td>1word</td><td>Start address of input image bit. = 0x0000</td></tr>
<tr><td>0x1107(4359)</td><td>Read</td><td>1word</td><td>Start address of output image bit. =0x1000</td></tr>
<tr><td>0x1108(4360)</td><td>Read</td><td>1word</td><td>Size of input image bit.</td></tr>
<tr><td>0x1109(4361)</td><td>Read</td><td>1word</td><td>Size of output image bit.</td></tr>
<tr><td>0x110A(4362)</td><td>Read</td><td>1word</td><td>Update time for cyclic data change (same as 0x1028)</td></tr>
<tr><td>0x110C(4364)</td><td>Read</td><td>1word</td><td>Field power status</td></tr>
<tr><td>0x110D(4365)</td><td>Read</td><td>1word</td><td>Current Dip Switch State.<br>ex) DHCP/Bootp enable, Dip SW(0x01) = 0x0101</td></tr>
<tr><td>0x110E(4366)</td><td>Read</td><td>upto 65word</td><td>Expansion slot’s GT-number including GN<br>First 1word is adapter’s number, if RIO3-MBR, then 0x9273</td></tr>
<tr><td>0x1110(4368)</td><td>Read</td><td>1word</td><td>Number of expansion slot</td></tr>
<tr><td>0x1113(4371)</td><td>Read</td><td>upto 65word</td><td>Expansion slot Module Id. Refer to Appendix A.1 Product List.<br>First 1word is adapter’s module id.</td></tr>
<tr><td>0x1119(4377)</td><td>Read</td><td>1word</td><td>Hi byte is Modbus status, low byte is internal status.<br>Zero value means ‘no error’.
<table>
<tr><th>Modbus status</th><th>Internal bus status(G-Bus)</th></tr>
<tr><td>0X00 :No Error<br>0X01: ERR_DIP_SWITCH<br>0X40:ERR_CRC_LRC<br>0X80: ERR_WATCHDOG</td><td>0X00 : OPERATING<br>0X01 : COMMUNICATION_FAULT<br>0X02 : CONNECT_FAULT<br>0X03 : CONFIG_FAULT<br>0X04: NO_EXPANSION<br>0X05: INVALID_ATTR_VALUE<br>0X06: TOO_MUCH_DATA<br>0X07: VENDOR_ERROR<br>0X08: NOT_EXPECTED_SLOT<br>0X09: CRC_ERROR<br>0X80: NO_FIELD_POWER</td></tr>
</table></td></tr>
<tr><td>0x111D(4381)</td><td>Read</td><td>1word</td><td>Adapter HX-RIO3 Revision.</td></tr>
</table>

* After the system is reset, the new “Set Value” action is applied.

** If the slot location is changed, set default value automatically (all expansion slot are live).

## 6.4.4. Expansion Slot Information Special Resister (0x2000, 8192)

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

Slot#1 0x2000(8192)~0x201F(8223) Slot#2 0x2020(8224)~0x203F(8255)
Slot#3 0x2040(8256)~0x205F(8287) Slot#4 0x2060(8288)~0x207F(8319)
Slot#5 0x2080(8320)~0x209F(8351) Slot#6 0x20A0(8352)~0x20BF(8383)
Slot#7 0x20C0(8384)~0x20DF(8415) Slot#8 0x20E0(8416)~0x20FF(8447)
Slot#9 0x2100(8448)~0x211F(8479) Slot#10 0x2120(8480)~0x213F(8511)
Slot#11 0x2140(8512)~0x215F(8543) Slot#12 0x2160(8544)~0x217F(8575)
Slot#13 0x2180(8576)~0x219F(8607) Slot#14 0x21A0(8608)~0x21BF(8639)
Slot#15 0x21C0(8640)~0x21DF(8671) Slot#16 0x21E0(8672)~0x21FF(8703)
Slot#17 0x2200(8704)~0x221F(8735) Slot#18 0x2220(8736)~0x223F(8767)
Slot#19 0x2240(8768)~0x225F(8799) Slot#20 0x2260(8800)~0x227F(8831)
Slot#21 0x2280(8832)~0x229F(8863) Slot#22 0x22A0(8864)~0x22BF(8895)
Slot#23 0x22C0(8896)~0x22DF(8927) Slot#24 0x22E0(8928)~0x22FF(8959)
Slot#25 0x2300(8960)~0x231F(8991) Slot#26 0x2320(8992)~0x233F(9023)
Slot#27 0x2340(9024)~0x235F(9055) Slot#28 0x2360(9056)~0x237F(9087)
Slot#29 0x2380(9088)~0x239F(9119) Slot#30 0x23A0(9120)~0x23BF(9151)
Slot#31 0x23C0(9152)~0x23DF(9183) Slot#32 0x23E0(9184)~0x23FF(9215)
Slot#33 0x2400(9216)~0x241F(9247) Slot#34 0x2420(9248)~0x243F(9279)
…..
Slot#63 0x27C0(10176)~0x27DF(10207)

| Address Offset | Expansion Slot#1 | Expansion Slot#2 | Expansion Slot#3 | Expansion Slot#4 | … | Expansion Slot#63 |
|---|---|---|---|---|---|---|
| + 0x00(+0) | 0x2000(8192) | 0x2020(8224) | 0x2040(8256) | 0x2060(8288) | … | 0x27C0(10176) |
| + 0x01(+1) | 0x2001(8193) | 0x2021(8225) | 0x2041(8257) | 0x2061(8289) | … | 0x27C1(10177) |
| + 0x02(+2) | 0x2002(8194) | 0x2022(8226) | 0x2042(8258) | 0x2062(8290) | … | 0x27C2(10178) |
| + 0x03(+3) | 0x2003(8195) | 0x2023(8227) | 0x2043(8259) | 0x2063(8291) | … | 0x27C3(10179) |
| + 0x04(+4) | 0x2004(8196) | 0x2024(8228) | 0x2044(8260) | 0x2064(8292) | … | 0x27C4(10180) |
| + 0x05(+5) | 0x2005(8197) | 0x2025(8229) | 0x2045(8261) | 0x2065(8293) | … | 0x27C5(10181) |
| + 0x06(+6) | 0x2006(8198) | 0x2026(8230) | 0x2046(8262) | 0x2066(8294) | … | 0x27C6(10182) |
| + 0x07(+7) | 0x2007(8199) | 0x2027(8231) | 0x2047(8263) | 0x2067(8295) | … | 0x27C7(10183) |
| + 0x08(+8) | 0x2008(8200) | 0x2028(8232) | 0x2048(8264) | 0x2068(8296) | … | 0x27C8(10184) |
| + 0x09(+9) | 0x2009(8201) | 0x2029(8233) | 0x2049(8265) | 0x2069(8297) | … | 0x27C9(10185) |
| + 0x0A(+10) | 0x200A(8202) | 0x202A(8234) | 0x204A(8266) | 0x206A(8298) | … | 0x27CA(10186) |
| + 0x0B(+11) | 0x200B(8203) | 0x202B(8235) | 0x204B(8267) | 0x206B(8299) | … | 0x27CB(10187) |
| + 0x0C(+12) | 0x200C(8204) | 0x202C(8236) | 0x204C(8268) | 0x206C(8300) | … | 0x27CC(10188) |
| + 0x0D(+13) | 0x200D(8205) | 0x202D(8237) | 0x204D(8269) | 0x206D(8301) | … | 0x27CD(10189) |
| + 0x0E(+14) | 0x200E(8206) | 0x202E(8238) | 0x204E(8270) | 0x206E(8302) | … | 0x27CE(10190) |
| + 0x0F(+15) | 0x200F(8207) | 0x202F(8239) | 0x204F(8271) | 0x206F(8303) | … | 0x27CF(10191) |
| + 0x10(+16) | 0x2010(8208) | 0x2030(8240) | 0x2050(8272) | 0x2070(8304) | … | 0x27D0(10192) |

| | | | | | | |
|---|---|---|---|---|---|---|
| + 0x11(+17) | 0x2011(8209) | 0x2031(8241) | 0x2051(8273) | 0x2071(8305) | … | 0x27D1(10193) |
| + 0x12(+18) | 0x2012(8210) | 0x2032(8242) | 0x2052(8274) | 0x2072(8306) | … | 0x27D2(10194) |
| + 0x13(+19) | 0x2013(8211) | 0x2033(8243) | 0x2053(8275) | 0x2073(8307) | … | 0x27D3(10195) |
| + 0x14(+20) | 0x2014(8212) | 0x2034(8244) | 0x2054(8276) | 0x2074(8308) | … | 0x27D4(10196) |
| + 0x15(+21) | 0x2015(8213) | 0x2035(8245) | 0x2055(8277) | 0x2075(8309) | … | 0x27D5(10197) |
| + 0x16(+22) | 0x2016(8214) | 0x2036(8246) | 0x2056(8278) | 0x2076(8310) | … | 0x27D6(10198) |
| + 0x17(+23) | 0x2017(8215) | 0x2037(8247) | 0x2057(8279) | 0x2077(8311) | … | 0x27D7(10199) |
| + 0x18(+24) | 0x2018(8216) | 0x2038(8248) | 0x2058(8280) | 0x2078(8312) | … | 0x27D8(10200) |
| + 0x19(+25) | 0x2018(8217) | 0x2038(8249) | 0x2058(8281) | 0x2078(8313) | … | 0x27D9(10201) |
| + 0x1A(+26) | 0x201A(8218) | 0x203A(8250) | 0x205A(8282) | 0x207A(8314) | … | 0x27DA(10202) |
| + 0x1B(+27) | 0x201B(8219) | 0x203B(8251) | 0x205B(8283) | 0x207B(8315) | … | 0x27DB(10203) |
| + 0x1C(+28) | 0x201C(8220) | 0x203C(8252) | 0x205C(8284) | 0x207C(8316) | … | 0x27DC(10204) |
| + 0x1D(+29) | 0x201D(8221) | 0x203D(8253) | 0x205D(8285) | 0x207D(8317) | … | 0x27DD(10205) |
| + 0x1E(+30) | 0x201E(8222) | 0x203E(8254) | 0x205E(8286) | 0x207E(8318) | … | 0x27DE(10206) |
| + 0x1F(+31) | 0x201F(8223) | 0x203F(8255) | 0x205F(8287) | 0x207F(8319) | … | 0x27DF(10207) |

| Address Offset | Access | Type, Size | Description |
|---|---|---|---|
| + 0x00(+0) | Read | 1word | Reserved |
| + 0x01(+1) | Read | 1word | Reserved |
| + 0x02(+2) ** | Read | 1word | Input start register address of input image word this slot. |
| + 0x03(+3) ** | Read | 1word | Input word's bit offset of input image word this slot. |
| + 0x04(+4) ** | Read | 1word | Output start register address of output image word this slot. |
| + 0x05(+5) ** | Read | 1word | Output word's bit offset of output image word this slot. |
| + 0x06(+6) ** | Read | 1word | Input bit start address of input image bit this slot. |
| + 0x07(+7) ** | Read | 1word | Output bit start address of output image bit this slot. |
| + 0x08(+8) ** | Read | 1word | Size of input bit this slot |
| + 0x09(+9) ** | Read | 1word | Size of output bit this slot |
| + 0x0A(+10)** | Read | n word | Read input data this slot |
| + 0x0B(+11)** | Read/Write | n word | Read/write output data this slot |
| + 0x0C(+12) * | Read/Write | 1word | Reserved |
| + 0x0E(+14) | Read | 1word | GT-number, if GT-1238, returns 0x1238 |
| + 0x0F(+15) | Read | String upto 72byte | First 1word is length of valid character string.<br>If GT-1238, returns<br>"00 1E 52 54 2D 31 32 33 38 2C 20 38 44 49 2C 20 32 34 56 64 63 2C 20 55 6E 69 76 65 72 73 61 6C 00 00"<br>Valid character size = 0x001E =30 characters,<br>"GT-1238, 8DI, 24Vdc, Universal" |
| + 0x10(+16) | Read | 1word | Size of configuration parameter byte |
| + | Read/Write | n word | Read/write Configuration parameter data, up to 8byte. |

| | | | |
|---|---|---|---|
| 0x11(+17)** | | | Refer to A.2 *** |
| + 0x12(+18) | Read | 1word | Reserved |
| + 0x13(+19)** | Read/Write | n word | Reserved |
| + 0x14(+20)** | Read/Write | n word | Reserved |
| + 0x15(+21) | Read | 2word | Reserved |
| + 0x16(+22) | Read | 2word | Reserved |
| + 0x17(+23) | Read | 2word | Firmware Revision<br>ex) 0x00010010 (Major revision 1 /Minor revision 1, Rev 1.001) |
| + 0x18(+24) | Read | 1word | Reserved |
| + 0x1A(+26) | Read/Write | n word | Reserved |
| + 0x1B(+27) | Read/Write | n word | Reserved |

* After the system is reset, the new “Set Value” action is applied.

** Nothing of output, input, memory or configuration parameter corresponding slot returns Exception 02.

Table 3.3.1. IO Data Code Format (1word)

| **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 | | | | | | Data Type | | Data Length | | | | | | |
| **Example)** | | | | | | | | | | | | | | | | | |
| GT-3214 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0x0084 |
| GT-1224 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0x00C4 |
| GT-1228 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0x0041 |
| GT-4123 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x8200 |
| GT-221F | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0x4200 |
| GT-2324 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0xC4C4 |

| | |
|---|---|
| **Input/output Type**:<br>0 0: No I/O Data<br>0 1: Byte Data<br>1 0: Word Data<br>1 1: Bit Data | **Input/output Data Length**:<br>0 0 0 0 0 0: 0 Bit/Byte/Word<br>0 0 0 0 0 1: 1 Bit/Byte/Word<br>0 0 0 0 1 0: 2 Bit/Byte/Word<br>0 0 0 0 1 1: 3 Bit/Byte/Word<br>…<br>1 1 1 1 1 1: 63 Bit/Byte/Word |

## 6.5. MODBUS Reference

MODBUS Reference Documents
http://www.modbus.org
MODBUS Tools
http://www.modbustools.com, modbus poll
http://www.win-tech.com, modscan32

# 7. Troubleshooting

## 7.1. How to diagnose by LED indicator

| LED Status | Cause | Action |
|---|---|---|
| All LED turns off | - No power | - Check main power Cable |
| | - System power is not supplied. | - Contact Sales team and send module for repair. |
| MOD LED flashes green | - Failure of initialization EEPROM parameter. | - Contact Sales team and send module for repair. |
| MOD LED flashes red | - Excess of expansion slot<br>- Excess of IO size<br>- Wrong IO composition<br>- Occurrence of EEPROM checksum error | - Use expansion slot up to 32.<br>- Compose that IO total size is not excess.<br>- Check composition I/O Module |
| MOD LED is red | - Wrong address ID<br>- Occurrence critical error in firmware | - Contact Sales team and send module for repair. |
| I/O LED turns off | - Failure of realization expansion Module<br>- None expansion Module | - Check connector status both NA series and expansion module. |
| I/O LED flashes red | Failure of configuration baud rate | - Check communication cable with Master<br>- Check power for master. |
| | Failure of initialization I/O | - Use expansion slot up to 32.<br>- Compose that I/O total size is not excess. |
| | | NA series notice unidentified expansion module ID. Check status of expansion module. |
| I/O LED is red | Failure of exchanging I/O data | Check status of expansion I/O connection. |
| NET LED turns off | Failure of communication with Master | Check main power for master and communication cable. |
| NET LED flashed green | Failure of exchanging data with master | Check status in software for Master configuration. |
| NET LED is red | Communication connecting lost | Check BUS line cable for connection with master. |
| | | Check duplication address. |

## 7.2. How to diagnose when device couldn't communicate network

**Inspection of wrong or omission cable connection.**

- Check status of cable connection for each node.
- Check that all color matches between connector and cable.
- Check wire omission.

**Terminator resistor**

- If terminator resistor is not installed, install terminator resistor
- Check location of terminator resistor

**Configuration of Node address**

- Check duplication node address.

**Configuration of Master**

- Check configuration of master
- Check whether to do download or don't
- Check composition is right
- Configuration of communication baud rate
- I/O size
- Configuration of each node

**Ground and environment**

- Check ground is contacted
- Check environment factor (temperature, humidity, etc.) is in less than regular limit

# APPENDIX A

## A.1. Product List

| No. | RIO3-Number | Description | ID (hex) |
|---|---|---|---|
| **Digital Input Module** | | | |
| 01 | RIO3-XDP8 | 8 Points, Universal, 24Vdc, 10RTB | 1238 |
| 02 | RIO3-XDP16C | 16 Points, Universal, 24Vdc, 20P connector | 123F |
| 03 | RIO3-XDP16T | 16 Points, Universal, 24Vdc, 18RTB | 12DF |
| 04 | RIO3-XDP32C | 32 Points, Universal, 24Vdc, 40P connector | 12FA |
| 05 | RIO3-XY16T | 8 Sink Input / 8 Source Output with Diagnostic, 24Vdc | 1428 |
| 06 | RIO3-XAH4 | 4 Points, 240Vac, 10RTB | 1904 |
| **Digital Output Module** | | | |
| 07 | RIO3-YTP8 | 8 Points, Source, 24Vdc/0.5A, 10RTB | 2328 |
| 08 | RIO3-YTP16C | 16 Points, Source, 24Vdc/0.3A, 20P connector | 222F |
| 09 | RIO3-YTP16T | 16 Points, Source, 24Vdc/0.3A, 18RTB | 226F |
| 10 | RIO3-YTP32C | 32 Points, Source, 24Vdc/0.3A, 40P connector | 22CA |
| 11 | RIO3-YS4 | 4 Points, MOS Relay, 240Vdc/ac, 0.5A, 10RTB | 2734 |
| 12 | RIO3-YS8 | 8 Points, MOS Relay Output Terminal, 240Vdc, 0.5A | 2738 |
| 13 | RIO3-YR4 | 4 Points, Relay, 24Vdc/2A, 240Vac/2A, 10RTB | 2744 |
| **Analog Input Module** | | | |
| 14 | RIO3-LDC2 | 2ch load cell input unit, strain gauge | 3002 |
| 15 | RIO3-AX4I | 4 Channels, 0~20, 4~20mA, 12bits, 10RTB | 3114 |
| 16 | RIO3-AXH4I | 4 Channels, 0~20, 4~20mA, 16bits, 10RTB | 3154 |
| 17 | RIO3-AX8I | 8 Channels, 0~20, 4~20mA, 12bits, 10RTB | 3118 |
| 18 | RIO3-AXH8I | 8 Channels, 0~20, 4~20mA, 16bits, 10RTB | 3158 |
| 19 | RIO3-AX16IC | 16 Channels, 0~20, 4~20mA, 12bits, 20P connector | 311F |
| 20 | RIO3-AX16IT | 16 Channels, 0~20, 4~20mA, 12bits, 18RTB | 317F |
| 21 | RIO3-AX4V | 4 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 10RTB | 3424 |
| 22 | RIO3-AXH4V | 4 Channels, 0~10, 0~5, 1~5Vdc, 16bits, 10RTB | 3464 |
| 23 | RIO3-AX8V | 8 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 10RTB | 3428 |
| 24 | RIO3-AXH8V | 8 Channels, 0~10, 0~5, 1~5Vdc, 16bits, 10RTB | 3468 |
| 25 | RIO3-AX16VC | 16 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 20P connector | 342F |
| 26 | RIO3-AX16VT | 16 Channels, 0~10, 0~5, 1~5Vdc, 12bits, 18RTB | 347F |
| 27 | RIO3-RTD4T | 4 Channels, RTD, 10RTB | 3704 |
| 28 | RIO3-RTD8C | 8 Channels, RTD, 20P connector | 3708 |
| 29 | RIO3-TC4T | 4 Channels, Thermocouple, 10RTB | 3804 |
| 30 | RIO3-E3AC | AC Measurement | 3901 |
| **Analog Output Module** | | | |
| 31 | RIO3-AY4I | 4 Channels, Current Output, 4~20mA, 12bits | 4214 |
| 32 | RIO3-AYH4I | 4 Channels, Current Output, 4~20mA, 16bits | 4254 |
| 33 | RIO3-AY8I | 8 CHANNELS CURRENT OUTPUT, 4~20mA, 12BIT | 4218 |

| | | | |
|---|---|---|---|
| 34 | RIO3-AY4V | 4CH, 0~10Vdc, 12Bits, 10RTB | 4424 |
| 35 | RIO3-AYH4V | 4CH, 0~10Vdc, 16Bits, 10RTB | 4464 |
| 36 | RIO3-AY8V | 8CH, 0~10Vdc, 12Bits, 10RTB | 4428 |
| 37 | RIO3-AY16VC | 16CH, 0~10Vdc, 12Bits, 20P Connector | 442F |
| 38 | RIO3-AY16VT | 16CH, 0~10Vdc, 12Bits, 18RTB | 447F |
| **Special Module** | | | |
| 39 | RIO3-CU24L | High Speed Counter, 2CHs, 24Vdc, Encoder Input, 10RTB | |
| 40 | RIO3-RS232 | 1CH, RS 232, RTS/CTS, Full Duplex Type, 10RTB | 5211 |
| 41 | RIO3-RS485 | 1CH, RS 485, Half Full Duplex Type, 10RTB | 5231 |
| 42 | RIO3-PWM2 | PWM Output, 2CHs, 0.5A/24Vdc, Source, 18RTB | 5442 |
| 43 | RIO3-PO2 | Pulse Output, 2CHs, 0.5A/24Vdc, Source, 18RTB | 5642 |
| **Power Module** | | | |
| 44 | RIO3-SHD | Shield Module | 7408 |
| 45 | RIO3-0VDC | Common for 0Vdc | 7508 |
| 46 | RIO3-PSD | Power Expansion, In 24Vdc, Out 1A/5Vdc | 7511 |
| 47 | RIO3-24VDC | Common for 24Vdc | 7518 |
| 48 | RIO3-VDC | Common for 0Vdc, 24Vdc | 7588 |
| 49 | RIO3-PS | Field Power, 5/24/48 Vdc, 110/220 Vac | 7641 |

## A.2. Glossary

- System Power : The power for starting up CPU.
- Field Power : The power for input and output line.
- Terminator Resistor : Resistor for prevention reflected wave.
- EDS : Electronic Data Sheet.
- Sink : The method of in/output power supply if a device has no power source.
- Source : The method of in/output power supply if a device has the power source.