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History

| REV. | PAGE<br>S     | REMARKS                                                                                                            | DATE       | Editor  |
|------|---------------|--------------------------------------------------------------------------------------------------------------------|------------|---------|
| -    |               | Preliminary                                                                                                        | 2018/6/18  | BS HA   |
| 1.00 |               |                                                                                                                    | 2019/04/03 | YM KIM  |
| 1.01 | 5,6,<br>39,40 | Image, UL Spec, Torque, Hotswap Function<br>Vibration, Product, ATEX certification                                 | 2020/05/25 | CW SEO  |
| 1.02 | 37            | Modify Firmware Revision                                                                                           | 2020/10/29 | CW SEO  |
| 1.03 |               | Remove Description pages of Hot Swap Function, Use in<br>Hazardous Environments and Caution(Before using the unit) | 2020/12/07 | SJ LIM  |
| 1.04 | 5             | Environment Specification Update                                                                                   | 2021/11/16 | EC KIM  |
| 1.05 | 5             | Certificate Update                                                                                                 | 2023/06/01 | CW SEO  |
| 1.06 | 2, 9, 17      | Document Number Added<br>Table of Contents Edited<br>Exception Indication Added<br>Hot Swap Objects Added          | 2024/09/19 | SH PARK |

## 1. ENVIRONMENT SPECIFICATION

| Environmental specification |                                                    |
|-----------------------------|----------------------------------------------------|
| Operating Temperature       | -25℃~60℃                                           |
| UL Temperature              | -25℃~60℃                                           |
| Storage Temperature         | -40℃~85℃                                           |
| Relative Humidity           | 5% ~ 90% non-condensing                            |
| Mounting                    | DIN rail                                           |
|                             |                                                    |
| General specification       |                                                    |
| Shock Operating             | IEC 60068-2-27                                     |
| Vibration Resistance        | IEC 60068-2-6, 4g                                  |
| Industrial Emissions        | EN 61000-6-4/A11 : 2011                            |
| Industrial Immunity         | EN 61000-6-2 : 2019                                |
| Installation Position       | Vertical and horizontal installation is available. |
| Product Certifications      | UL, ATEX, CE, UKCA, ABS, BV, CCS, DNV, KR, LR      |

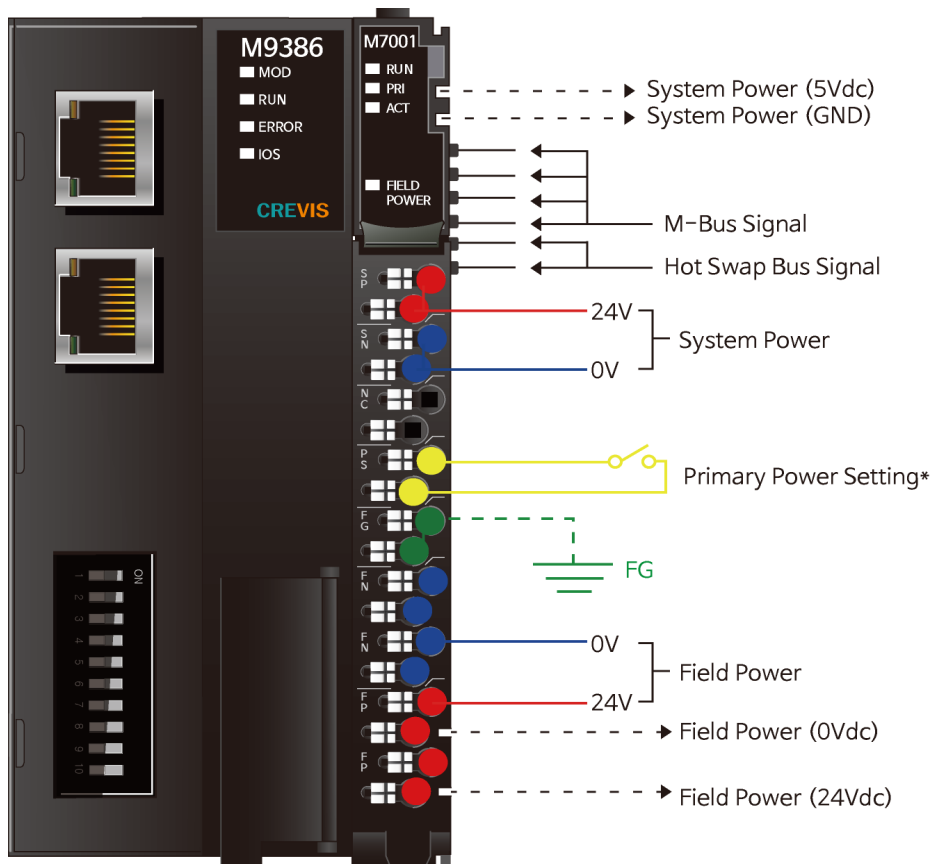
## 2. M9386 (EtherCAT ID Type Network Adapter)

### 2.1. M9386 Specification

| Items                                            | Specification                                                                                                                                                                                                                              |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Communication Interface Specification</b>     |                                                                                                                                                                                                                                            |
| Adapter Type                                     | Slave Node (EtherCAT)                                                                                                                                                                                                                      |
| Protocol                                         | EtherCAT                                                                                                                                                                                                                                   |
| Max. Expansion Slot                              | 63 slots                                                                                                                                                                                                                                   |
| I/O Data Size                                    | Max 128 bytes each slot                                                                                                                                                                                                                    |
| Max. Network Node                                | 65,535                                                                                                                                                                                                                                     |
| Baud Rate                                        | 100Mbps                                                                                                                                                                                                                                    |
| Bus Connection                                   | 2 x RJ-45                                                                                                                                                                                                                                  |
| Mac Address / IP Address                         | Not needed                                                                                                                                                                                                                                 |
| Other Serial Port                                | RS232 for MODBUS/RTU, Touch Panel or IOGuidePro                                                                                                                                                                                            |
| 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                                        | 4 LEDs<br>1 Green/Red, Module Status (MOD)<br>1 Green, Network Status (RUN)<br>1 Red, Error Status (ERROR)<br>1 Green/Red, Expansion I/O Module Status (IOS)<br>2 LEDs (each RJ45 Connector)<br>1 Yellow, Link/Active<br>1 Green, Not used |
| Module Location                                  | Starter module left side of M-Series system                                                                                                                                                                                                |
| <b>General specification (Supplied by M7001)</b> |                                                                                                                                                                                                                                            |
| UL System Power                                  | Supply voltage : 24Vdc nominal, Class 2                                                                                                                                                                                                    |
| System Power                                     | Supply voltage : 24Vdc nominal<br>Supply voltage range : 15~28.8Vdc<br>Protection : Output current limit, Reverse polarity protection                                                                                                      |
| Power Dissipation                                | 70mA typical @ 24Vdc                                                                                                                                                                                                                       |
| Current for I/O Module                           | 2.0A @ 5Vdc<br>(If except for NA, current for I/O module is about 1.5A)                                                                                                                                                                    |
| 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 : Class 2, 24Vdc typical (Max. 28.8Vdc)<br>* Field Power Range is different depending on IO Module series.<br>Refer to IO Module's Specification.                                                                           |
| Single Wire                                      | 0.205mm <sup>2</sup> - 1.3mm <sup>2</sup> (24-16 AWG)                                                                                                                                                                                      |
| Torque                                           | 0.8Nm (7 lb-in)                                                                                                                                                                                                                            |
| Max. Current Field Power Contact                 | DC 10A Max                                                                                                                                                                                                                                 |
| Weight                                           | 179g                                                                                                                                                                                                                                       |
| Module Size                                      | 54mm x 110mm x 75mm                                                                                                                                                                                                                        |
| <b>Environment Condition</b>                     | <b>Refer to '1. Environment Specification'</b>                                                                                                                                                                                             |

\* Class 2, adjacent to voltage rating (30Vmax)

## 2.2. M9386 Wiring Diagram



### \* Primary Power Setting (P.S pin)

- Short the P.S pin to set one of the two M7001 as the primary power.

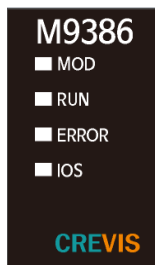
| Pin No. | Signal Description       |
|---------|--------------------------|
| 0       | SP System Power, 24V     |
| 1       | SN System Power, 0V(GND) |
| 2       | SP System Power, 24V     |
| 3       | SN System Power, 0V(GND) |
| 4       | NC                       |
| 5       | NC                       |
| 6       | PS Primary Power Setting |
| 7       | PS Primary Power Setting |
| 8       | FG F.G                   |
| 9       | FG F.G                   |
| 10      | FN Field Power 0V (GND)  |
| 11      | FN Field Power 0V (GND)  |
| 12      | FN Field Power 0V (GND)  |
| 13      | FN Field Power 0V (GND)  |
| 14      | FP Field Power 24V       |
| 15      | FP Field Power 24V       |
| 16      | FP Field Power 24V       |
| 17      | FP Field Power 24V       |

| Series No | Through Air | Over Surface | CTI         |
|-----------|-------------|--------------|-------------|
| RTB18C    | 1.5mm       | 1.5mm        | 175≤CTI≤400 |

Spacings : The following minimum spacing in inches (millimeters) shall be maintained between uninsulated live parts of opposite polarity; and between an uninsulated live part and a grounded Part including any mounting surface or exposed metal part.

## 2.3. M9386 LED Indicator

### 2.3.1. LED Indicator



| LED No. | LED Function / Description | LED Color |
|---------|----------------------------|-----------|
| MOD     | Module Status              | Green/Red |
| RUN     | Current Running Status     | Green     |
| ERROR   | Error Status (EtherCAT)    | Red       |
| IOS     | Extension Module Status    | Green/Red |

#### 2.3.2. MOD (Module Status LED)

| Status              | LED            | To indicate                                                                              |
|---------------------|----------------|------------------------------------------------------------------------------------------|
| Not Powered         | OFF            | power is not supplied to the unit.                                                       |
| Normal, Operational | Green          | The unit is operating in normal condition.                                               |
| Device in Standby   | Flashing Green | The EEPROM parameter is not initialized yet.<br>Serial Number is zero value (0x00000000) |
| Minor Fault         | Flashing Red   | The unit has occurred recoverable fault in self-testing.<br>- EEPROM checksum fault.     |
| Unrecoverable Fault | Red            | The unit has occurred unrecoverable fault in self-testing.<br>- Firmware fault           |

#### 2.3.3. RUN (Current Running Status LED)

| Status                      | LED          | To indicate                                                                            |
|-----------------------------|--------------|----------------------------------------------------------------------------------------|
| Init                        | OFF          | State of the EtherCAT State Machine: INIT = Initialization.                            |
| Pre-Operation               | Blinking     | State of the EtherCAT State Machine: PREOP = Pre-Operation.                            |
| Safe-Operation              | Single Flash | State of the EtherCAT State Machine: SAFEOP = Safe-Operation.                          |
| Initialization or Bootstrap | Flashes      | State of the EtherCAT State Machine: BOOT = Bootstrap (Update of the coupler firmware) |
| Operational                 | ON           | State of the EtherCAT State Machine: Operational.                                      |

#### 2.3.4. ERR (Error State LED)

| Status                | LED      | To indicate            |
|-----------------------|----------|------------------------|
| No Error              | OFF      | No Error.              |
| Invalid Configuration | Blinking | Invalid Configuration. |

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

| Status                                              | LED          | To indicate                                                                                                                                                                                                 |
|-----------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Not Powered                                         | OFF          | Device has no expansion module or may not be powered.                                                                                                                                                       |
| Incorrect IO Module                                 | Flashing Red | If Hotswap function is enable, configured module is incorrect.                                                                                                                                              |
| Internal Bus Connection, Run Exchanging I/O         | Green        | Exchanging I/O data.                                                                                                                                                                                        |
| Internal Bus Connection Fault during Exchanging I/O | Red          | One or more expansion module occurred in fault state.<br>- Changed expansion module configuration.<br>- Internal Bus communication failure.<br>- Mismatch vendor code between adapter and expansion module. |
| Expansion Configuration                             | Flashing     | Failed to initialize expansion module.                                                                                                                                                                      |



|        |     |                                                                                                                                                                                                                                           |
|--------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Failed | Red | <ul style="list-style-type: none"> <li>- Detect invalid expansion module ID.</li> <li>- Overflow Input/Output size.</li> <li>- No expansion module.</li> <li>- Too many expansion module.</li> <li>- Initial protocol failure.</li> </ul> |
|--------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 2.3.6. Exception Indication

| To indicate             | LED          |     |       |     |
|-------------------------|--------------|-----|-------|-----|
|                         | MOD          | RUN | ERROR | IOS |
| Overcurrent Consumption | Flashing Red | OFF | OFF   | Red |

## 2.4. M7001 LED Indicator

### 2.4.1. LED Indicator



| LED No.     | LED Function / Description | LED Color |
|-------------|----------------------------|-----------|
| RUN         | M-Bus Status               | Green     |
| PRI         | Primary Status             | Green     |
| ACT         | Active                     | Green     |
| Field Power | Field Power Enable         | Green     |

### 2.4.2. RUN(RUN Status LED)

| Status                    | LED   | To indicate                     |
|---------------------------|-------|---------------------------------|
| Main Power Module         | Green | Supplied 5Vdc system power.     |
| Substitution Power Module | Off   | Not Supplied 5Vdc system power. |

### 2.4.3. PRI(Primary Status LED)

| Status                    | LED   | To indicate                                            |
|---------------------------|-------|--------------------------------------------------------|
| Main Power Module         | Green | Primary power module.                                  |
| Substitution Power Module | Off   | Secondary power module or not use redundancy function. |

### 2.4.4. ACT(Active Status LED)

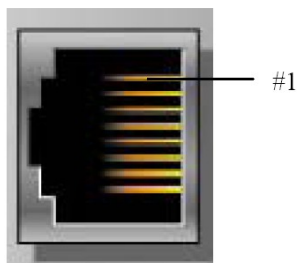
| Status                    | LED   | To indicate                                           |
|---------------------------|-------|-------------------------------------------------------|
| Main Power Module         | Green | When the Power Module is operating in main operation. |
| Substitution Power Module | Off   | Standby with Substitution Power Module.               |

### 2.4.5. Field Power LED (Field Power Status LED)

| Status               | LED   | To indicate                     |
|----------------------|-------|---------------------------------|
| No field power       | Off   | Not supplied 24Vdc field power. |
| Supplied field power | Green | Supplied 24Vdc field power.     |

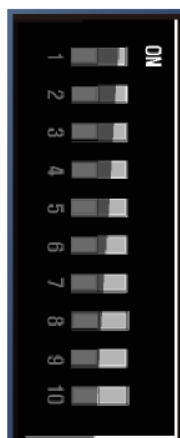
## 2.5. M9386 Electrical Interface

### 2.5.1. 5 Pin open connector



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

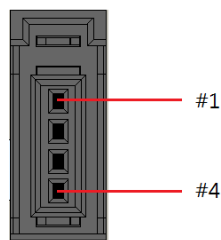
### 2.5.2. Dip Switch



| DIP Pole# | Description                    |
|-----------|--------------------------------|
| 1         | Identification Value DIP bit#0 |
| 2         | Identification Value DIP bit#1 |
| 3         | Identification Value DIP bit#2 |
| 4         | Identification Value DIP bit#3 |
| 5         | Identification Value DIP bit#4 |
| 6         | Identification Value DIP bit#5 |
| 7         | Identification Value DIP bit#6 |
| 8         | Identification Value DIP bit#7 |
| 9         | Not Used                       |
| 10        | Not Used                       |

### 2.5.3. RS232 Port for MODBUS/RTU

The configuration interface used for the communication with IO GuidePro or for firmware download.



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

## 2.6. EtherCAT ID Type Setup

### 2.6.1. Hot Connection On TwinCAT

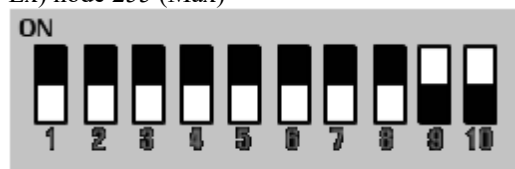
Hot connection function can be used to remove a node from a preconfigured Configuration or change the location of nodes and flexible. This feature is available only EtherCAT ID Type in TwinCAT.  
The user can use the external Dip Switch settings of the Adapter Identification Value.

For an example of using an external Dip Switch ( Refer to 2.4.2. )

Ex) node 1 (Min)

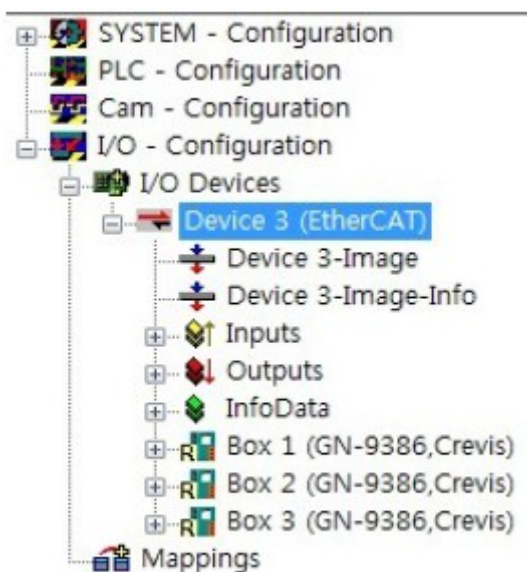


Ex) node 255 (Max)

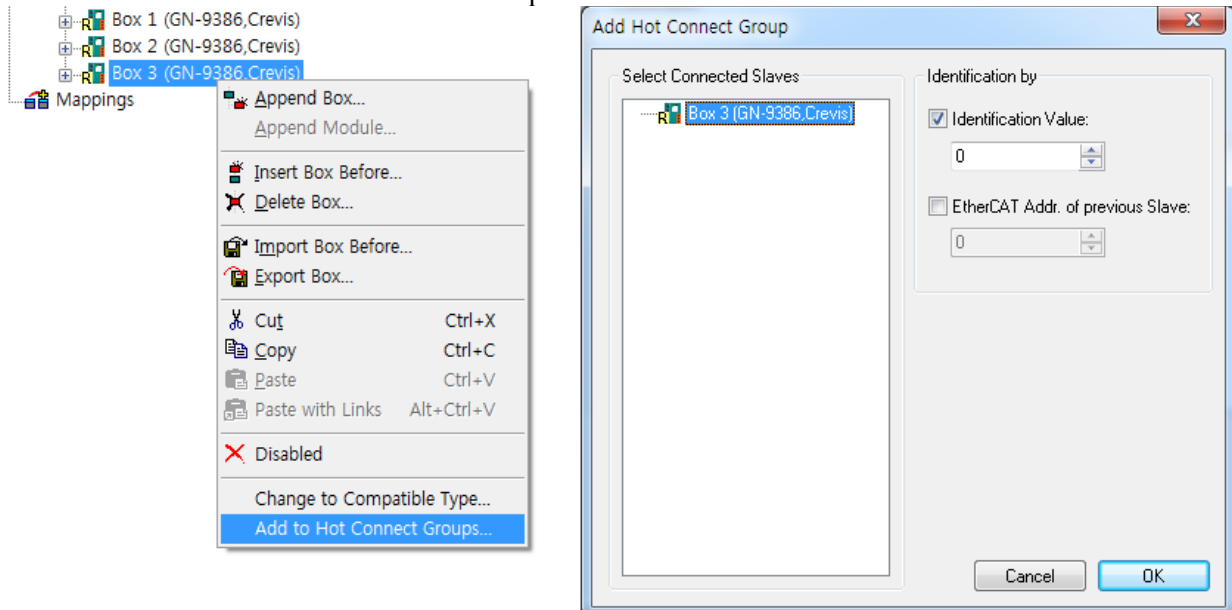


## Hot Connection setting procedure.

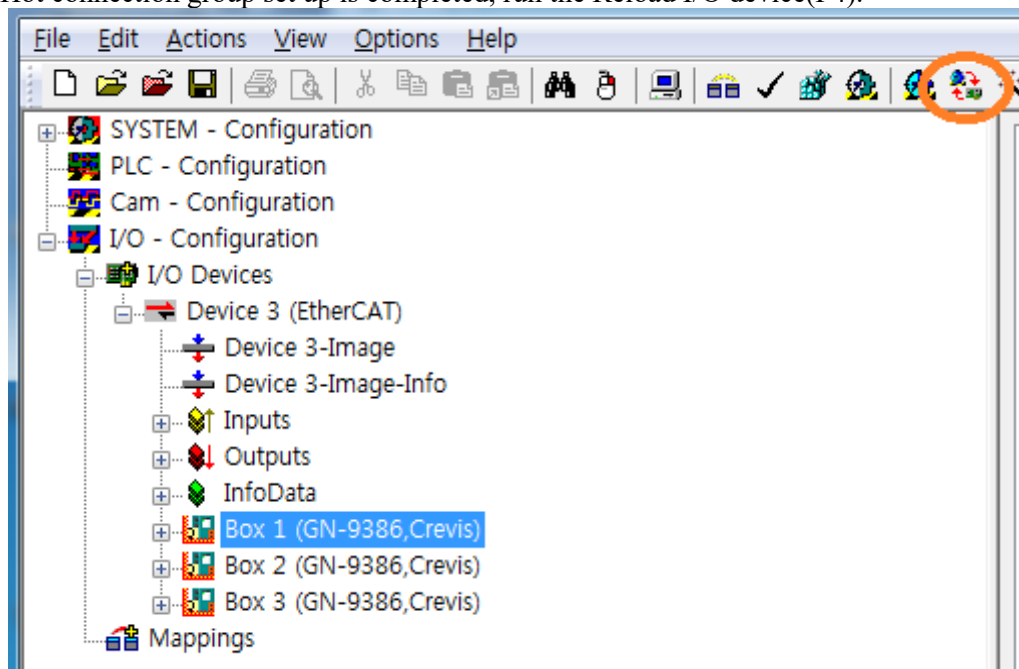
1. Add the EtherCAT ID Type in TwinCAT.



2. The Hot Connect Group settings.  
Set the identification value same as dip-switch.



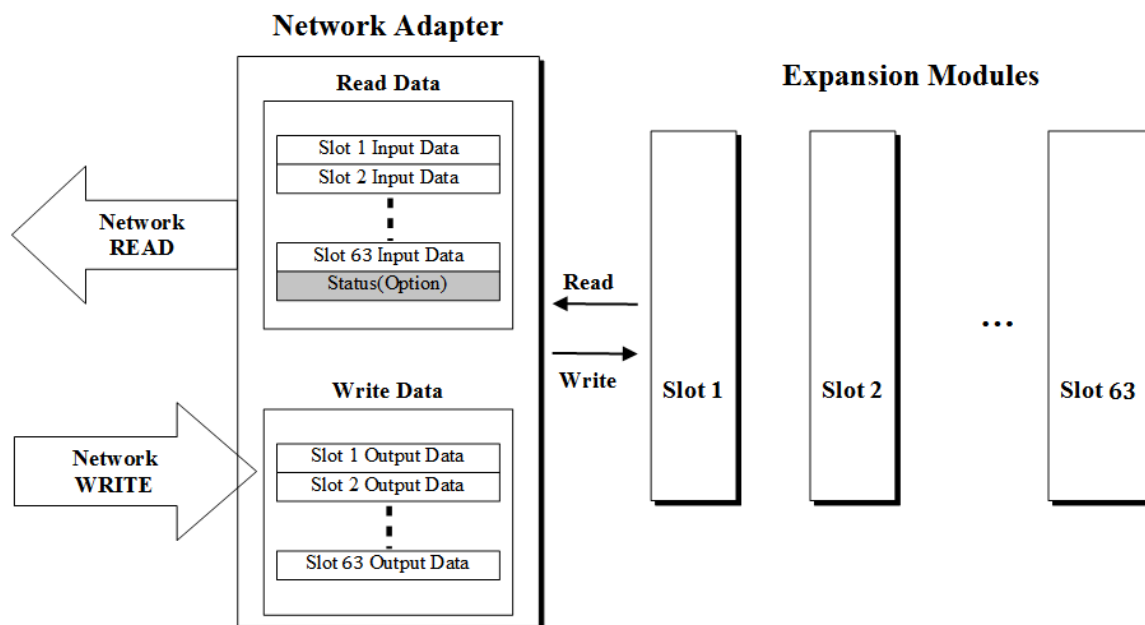
3. Hot connection group set up is completed, run the Reload I/O device(F4).



4. Now you can use the Hot connection feature.  
Node is not overlapped between products. If there are same nodes, It should be changed.

## 2.7. I/O 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 G-Series protocol. The following figure shows the data flow of process image between network adapter and expansion modules.

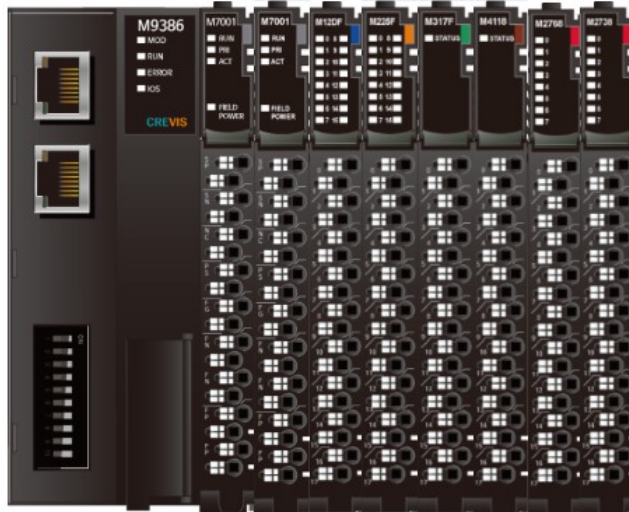


## Specification

### 2.7.1. 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.

- For example slot configuration



| Slot Address | Module Description |
|--------------|--------------------|
| #0           | EtherCAT Adapter   |
| #1           | Power module       |
| #2           | Power module       |
| #3           | 16-discrete input  |
| #4           | 16-discrete output |
| #5           | 16-analog input    |
| #6           | 8-discrete input   |
| #7           | 8-discrete output  |
| #8           | 8-discrete output  |

- Input Process Image

| TXPDO  | Entries | Byte | Bit 7                                | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|--------|---------|------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|
| 0x1A01 | 0x6010  | 0    | Power module (Slot#1)                |       |       |       |       |       |       |       |
| 0x1A02 | 0x6020  | 1    | Power module (Slot#2)                |       |       |       |       |       |       |       |
| 0x1A03 | 0x6030  | 2    | Analog Input Ch0 low byte (Slot#5)   |       |       |       |       |       |       |       |
|        |         | 3    | Analog Input Ch0 high byte (Slot#5)  |       |       |       |       |       |       |       |
|        |         | 4    | Analog Input Ch1 low byte (Slot#5)   |       |       |       |       |       |       |       |
|        |         | 5    | Analog Input Ch1 high byte (Slot#5)  |       |       |       |       |       |       |       |
|        |         | ...  | ...                                  |       |       |       |       |       |       |       |
|        |         | ...  | ...                                  |       |       |       |       |       |       |       |
|        |         | 30   | Analog Input Ch14 low byte (Slot#5)  |       |       |       |       |       |       |       |
|        |         | 31   | Analog Input Ch14 high byte (Slot#5) |       |       |       |       |       |       |       |
|        |         | 32   | Analog Input Ch15 low byte (Slot#5)  |       |       |       |       |       |       |       |
|        |         | 33   | Analog Input Ch15 high byte (Slot#5) |       |       |       |       |       |       |       |

- Output Process Image

| RXPDO  | Entries | Byte | Bit 7                                | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|--------|---------|------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|
| 0x1601 | 0x7010  | 0    | Discrete Output 8 pts (Slot#1)       |       |       |       |       |       |       |       |
| 0x1602 | 0x7020  | 1    | Discrete Output 8 pts (Slot#2)       |       |       |       |       |       |       |       |
| 0x1603 | 0x7030  | 2    | Analog Output Ch0 low byte (Slot#6)  |       |       |       |       |       |       |       |
|        |         | 3    | Analog Output Ch0 high byte (Slot#6) |       |       |       |       |       |       |       |
|        |         | 4    | Analog Output Ch1 low byte (Slot#6)  |       |       |       |       |       |       |       |
|        |         | 5    | Analog Output Ch2 high byte (Slot#6) |       |       |       |       |       |       |       |
|        |         | ...  | ...                                  |       |       |       |       |       |       |       |
|        |         | ...  | ...                                  |       |       |       |       |       |       |       |
|        |         | 14   | Analog Output Ch6 low byte (Slot#6)  |       |       |       |       |       |       |       |
|        |         | 15   | Analog Output Ch6 high byte (Slot#6) |       |       |       |       |       |       |       |
|        |         | 16   | Analog Output Ch7 low byte (Slot#6)  |       |       |       |       |       |       |       |
|        |         | 17   | Analog Output Ch7 high byte (Slot#6) |       |       |       |       |       |       |       |
| 0x1604 | 0x7040  | 10   | Discrete Output low 8 pts (Slot#7)   |       |       |       |       |       |       |       |
| 0x1605 | 0x7050  | 12   | Discrete Output low 8 pts (Slot#8)   |       |       |       |       |       |       |       |

## 3. EtherCAT Basics

The EtherCAT protocol uses an officially assigned EtherType inside the Ethernet Frame. The use of this EtherType allows transport of control data directly within the Ethernet frame without redefining the standard Ethernet frame. The frame may consist of several sub-telegrams, each serving a particular memory area of the logical process images that can be up to 4 gigabytes in size. Addressing of the Ethernet terminals can be in any order because the data sequence is independent of the physical order. Broadcast, Multi-cast and communication between slaves are possible

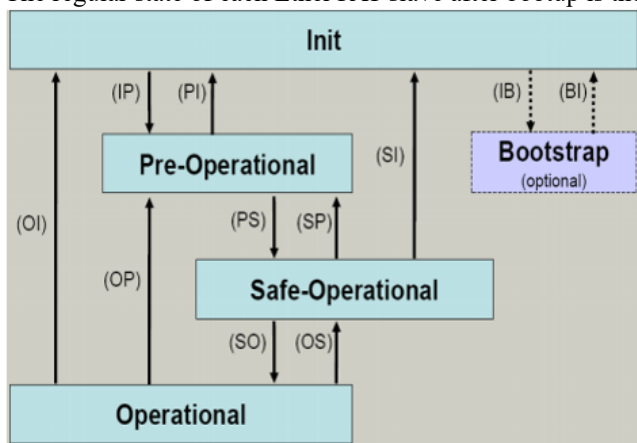
### 3.1. EtherCAT State Machine

The state of the EtherCAT slave is controlled via the EtherCAT State Machine (ESM). Depending upon the state, different functions are accessible or executable in the EtherCAT slave. Specific commands must be sent by the EtherCAT master to the device in each state, particularly during the boot up of the slave.

A distinction is made between the following states:

- Init
- Pre-Operational
- Safe-Operational and
- Operational
- Bootstrap

The regular state of each EtherCAT slave after bootup is the OP state.



#### Init

After switch-on the EtherCAT slave in the Init state. No mailbox or process data communication is possible. The EtherCAT master initializes sync manager channels 0 and 1 for mailbox communication.

#### Pre-Operational (Pre-Op)

During the transition between Init and Pre-Op the EtherCAT slave checks whether the mailbox was initialized correctly. In Pre-Op state mailbox communication is possible, but not process data communication. The EtherCAT master initializes the sync manager channels for process data (from sync manager channel 2), the FMMU channels and, if the slave supports configurable mapping, PDO mapping or the sync manager PDO assignment. In this state the settings for the process data transfer and perhaps terminal-specific parameters that may differ from the default settings are also transferred.

#### Safe-Operational (Safe-Op)

During transition between Pre-Op and Safe-Op the EtherCAT slave checks whether the sync manager channels for process data communication and, if required, the distributed clocks settings are correct. Before it acknowledges the change of state, the EtherCAT slave copies current input data into the associated DP-RAM areas of the EtherCAT slave controller (ECSC).

In Safe-Op state mailbox and process data communication is possible, although the slave keeps its outputs in a safe state, while the input data are updated cyclically.

## Operational (Op)

Before the EtherCAT master switches the EtherCAT slave from Safe-Op to Op it must transfer valid output data.

In the Op state the slave copies the output data of the masters to its outputs. Process data and mailbox communication is possible.

## Bootstrap

In the Boot state the slave firmware can be updated. The Boot state can only be reached via the Init state.

In the Boot state mailbox communication via the file access over EtherCAT (FoE) protocol is possible, but no other mailbox communication and no process data communication.

## 3.2. CoE Interface

### 3.2.1. parameter management in the EtherCAT system

The CiA organization (CAN in Automation) pursues among other things the goal of creating order and exchange ability between devices of the same type by the standardization of device descriptions. For this purpose so-called profiles are defined, which conclusively describe the changeable and unchangeable parameters of a device. Such a parameter encompasses at least the following characteristics:

- ✓ Index number – for the unambiguous identification of all parameters. The index number is divided into a main index and a subindex in order to mark and arrange associated parameters.
  - Main index
  - Subindex, offset by a colon ‘:’
- ✓ Official name – in the form of an understandable, self-descriptive text
- ✓ Specification of changeability, e.g. whether it can only be read or can also be written
- ✓ A value – depending upon the parameter the value can be a text, a number or another parameter index.

### Index Range

The relevant ranges for EtherCAT fieldbus users are:

**x1000** : This is where fixed identity information for the device is stored, including name, manufacturer, serial number etc., plus information about the current and available process data configurations.

**x8000** : This is where the operational and functional parameters for all channels are stored, such as filter settings or output frequency.

Other important ranges are:

**x4000** : In some EtherCAT devices the channel parameters are stored here (as an alternative to the x8000 range).

**x6000** : Input PDOs ("input" from the perspective of the EtherCAT master)

**x7000** : Output PDOs ("output" from the perspective of the EtherCAT master)



## 3.2.2. Communication Objects

| Index | Sub-index | Name                     | Flags | Default value                 |
|-------|-----------|--------------------------|-------|-------------------------------|
| 1000  |           | Device type              | RO    | 0x00001389                    |
| 1001  |           | Gbus Status              | RO    | Normal Operation : 0x03 **    |
| 1002  |           | Master Fault Action      | RW    | 0xA010                        |
| 1003  |           | Hot Swap Disable         | RW    | Enable : 0x00, Disable : 0x01 |
| 1004  |           | Hot Swap Error Detection | RO    | Error : 1, Normal : 0         |
| 1005  |           | Hot Swap Error           | RO    | 0x04                          |
|       |           | Error Slot 1~15          | RO    | 0x0000xxxx                    |
|       |           | Error Slot 16~31         | RO    | 0x0000xxxx                    |
|       |           | Error Slot 32~47         | RO    | 0x0000xxxx                    |
|       |           | Error Slot 48~63         | RO    | 0x0000xxxx                    |
| 1008  |           | Device name              | RO    | M9386(Crevis)                 |
| 1009  |           | Hardware version         | RO    | M9386.v1                      |
| 100A  |           | Software version         | RO    | 1.000                         |
| 1018  |           | Identity                 | RO    | 0x05                          |
|       | 01        | Vendor ID (Crevis: 029D) | RO    | 0x0000029D                    |
|       | 02        | Product code             | RO    | 0x004D9386                    |
|       | 03        | Revision                 | RO    | 0x00010000                    |
|       | 04*       | Serial number            | RO    | 0xFFFFFFFF                    |
|       | 05        | Release date             | RO    | 0x20160823                    |
| 10F1  |           | Error Settings           | RO    | 0x02                          |
|       | 01        | Local Error Reaction     | RO    | 0x00000000                    |
|       | 02        | Sync Error Counter Limit | RO    | 0x00000004                    |
| 1601* |           | Slot#x,Mxxxx,RXPDO       | RO    | 0xnn                          |
|       | 01        | SubIndex 001             | RO    | 0x7010:01, 8                  |
|       | ...       | ...                      | ...   | ...                           |
|       | nn        | SubIndex nnn             | RO    | 0x7010:nn, 8                  |
| 1A01* |           | Slot#x, Mxxxx, TXPDO     | RO    | 0xnn                          |
|       | 01        | SubIndex 001             | RO    | 0x6010:01, 8                  |
|       | ...       | ...                      | ...   | ...                           |
|       | nn        | SubIndex nnn             | RO    | 0x6010:nn, 8                  |
| 1C00  |           | Sync manager type        | RO    | 0x04                          |
|       | 01        | SubIndex 001             | RO    | 0x01                          |
|       | 02        | SubIndex 002             | RO    | 0x02                          |
|       | 03        | SubIndex 003             | RO    | 0x03                          |
|       | 04        | SubIndex 004             | RO    | 0x04                          |
| 1C12  |           | RxPDO assign             | RO    | 0x01                          |
|       | 01        | SubIndex 001             | RO    | 0x1601                        |
| 1C13  |           | TxPDO assign             | RO    | 0x02                          |

|       |                            |                           |      |            |
|-------|----------------------------|---------------------------|------|------------|
|       | 01                         | SubIndex 001              | RO   | 0x1A01     |
|       | 02                         | SubIndex 002              | RO   | 0x1A02     |
| 7010* | Mxxxx                      |                           | RO   | 0xnn       |
|       | 01                         | Byte#0                    | RW P | 0x00       |
|       | ...                        | ...                       | ...  | ...        |
|       | nn                         | Byte#nnn                  | RW P | 0x00       |
| 8000  | M9386(Parameter)           |                           | RO   |            |
|       | 01                         | Byte#0                    | RW   |            |
|       | 02                         | Byte#1                    | RW   |            |
|       | 03                         | Byte#2                    | RW   |            |
|       | 04                         | Byte#3                    | RW   |            |
| 8nn0* | Mxxxx(Parameter)           |                           | RO   |            |
|       | 01                         | Byte#0                    | RW   |            |
|       | ...                        | ...                       | ...  | ...        |
|       | nn                         | Byte#nnn                  | RW   |            |
| F000  | Module device profile      |                           | RO   |            |
|       | 01                         | Module index distance     | RO   |            |
|       | 02                         | Maximum numver of modules | RO   |            |
| F010* | Module List                |                           | RO   |            |
|       | 01                         | Subindex 001 (M9386)      | RO   | 0x00009386 |
|       | ...                        | ...                       | ...  | ...        |
|       | 63                         | Subindex 063              | RO   | 0x0000xxxx |
| F050  | Detected Module Ident List |                           | RO   |            |
|       | 01...                      | SubIndex 001              | RO   |            |

\*This value can be changed depending on the configuration of expansion modules

\*\* Mbus Status

0x01 : INIT\_STATE

0x02 : IDLE\_STATE

0x03 : RUN\_STATE

0x04 : STOP\_STATE

0x05 : FAULT\_STATE

0x06 : RESET\_STATE

0x07 : CRCERR\_STATE

0x08 : PAUSE\_STATE

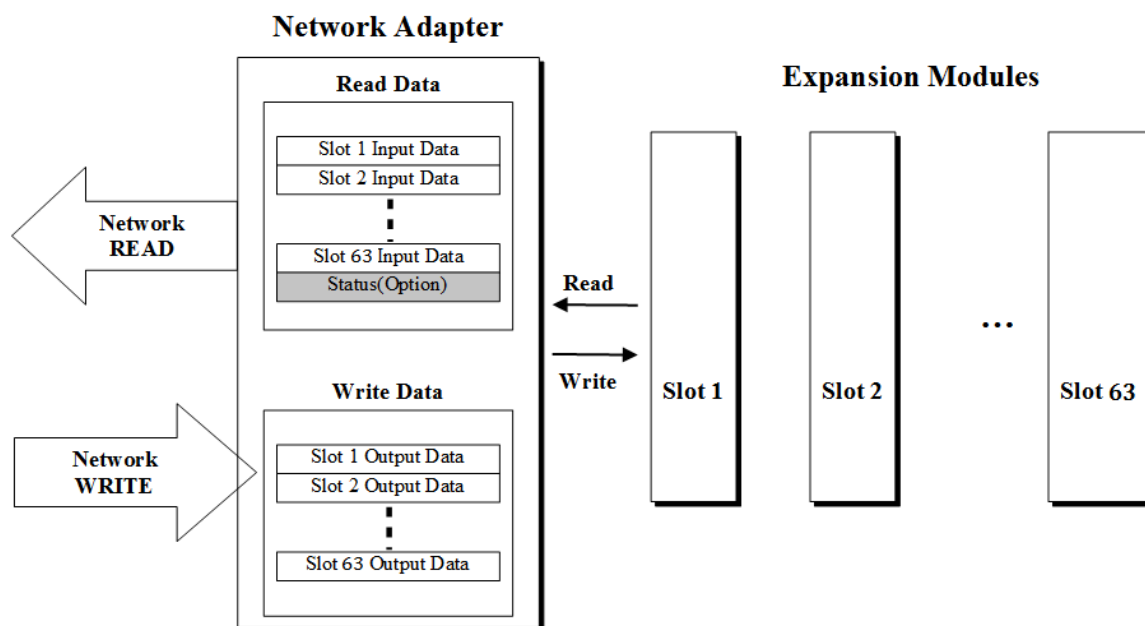
0x80\* : At Hot swap mode

expansion module error

## 4. MODBUS INTERFACE

### 4.1. 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 M-Series protocol. The following figure shows the data flow of process image between network adapter and expansion modules.



#### 4.1.1. 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 register 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 register areas are addressable by bit address.<br>Size of output image bit is size of output image register * 16. | 1,5,15     |

## 4.2. 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 register 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 register areas are addressable by bit address.<br>Size of output image bit is size of output image register * 16. | 1,5,15     |

## 4.3. 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

## 4.4. 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.

### 4.4.1. 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 |

### 4.4.2. 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 |

### 4.4.3. 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       |

## 4.4.4. 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        |

## 4.4.5. 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.

## 4.4.6. 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, 0x0A       |

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

## 4.4.7. 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, 0x0A       |

### • 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, 0x0A       |

- Output bit of address 0x1001 turns ON.

## 4.4.8. 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.

## 4.4.9. 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+0xAA55+Sumcheck | Echo Request Data     | Reset with Factory |

## 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 1 word of input process image.

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

## 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  |             |

### 4.4.10. 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.

## 4.4.11. 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.

## 4.4.12. 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, 0x0A       |

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

## 4.4.13. 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.                                           |

- M9386 response exception code 01, 02, 03, 04 and 06.

## 4.5. 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).

### 4.5.1. Adapter Identification Special Register (0x1000, 4096)

| Address      | Access | Type, Size                                                              | Description                                                                                                                                                                                                                                          |
|--------------|--------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x1000(4096) | Read   | 1word                                                                   | Vendor ID = 0x029D(669), Crevis. Co., Ltd.                                                                                                                                                                                                           |
| 0x1001(4097) | Read   | 1word                                                                   | Device type = 0x000C, Network Adapter                                                                                                                                                                                                                |
| 0x1002(4098) | Read   | 1word                                                                   | Product Code = 0xA010                                                                                                                                                                                                                                |
| 0x1003(4099) | Read   | 1word                                                                   | Firmware revision, if 0x0101, revision 1.01                                                                                                                                                                                                          |
| 0x1004(4100) | Read   | 2word                                                                   | Product unique serial number                                                                                                                                                                                                                         |
| 0x1005(4101) | Read   | String<br>upto 34byte                                                   | Product name string (ASCII)<br>“M9386,EtherCAT ID Type,M-Series”                                                                                                                                                                                     |
| 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>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

### 4.5.2. Adapter Hotswap Register (0x1060, 4192)

| Address       | Access         | Type, Size | Description                                                           |
|---------------|----------------|------------|-----------------------------------------------------------------------|
| 0x1060(4192)  | Read/<br>Write | 1word      | Hot swap status    0 : Enable<br>1 : Disable                          |
| 0x1062(4194)* | Read           | 1word      | Error slot detection<br>0 : No error slot<br>1 : Error slot detection |
| 0x1063(4195)* | Read           | 4word      | Error slot location, 8x8 bit                                          |

\* 0x1062 and 0x1063 functions are only available if hot swap(0x1060) is enabled.

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

| Address                                                                                     | Access                                                                                                                                                                                                                                                        | Type, Size  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|----------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x1100(4352)*                                                                               | Read/Write                                                                                                                                                                                                                                                    | 1 word      | Master fault action option. (Disable : 0x0000, Enable : 0x0001)<br>This option can enable Master fault action option.<br>With master fault action, fault action can be activated with master communication failure. Also, can activate hold last state as IO parameter.                                                                                                                                                                                                                                                                                                    |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1102(4354)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Start address of input image word register. =0x0000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1103(4355)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Start address of output image word register. =0x0800                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1104(4356)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Size of input image word register.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1105(4357)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Size of output image word register.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1106(4358)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Start address of input image bit. = 0x0000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1107(4359)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Start address of output image bit. =0x1000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1108(4360)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Size of input image bit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1109(4361)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Size of output image bit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x110A(4362)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Update time for cyclic data change (same as 0x1028)<br>(Unit : us)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x110E(4366)                                                                                | Read                                                                                                                                                                                                                                                          | upto 33word | Expansion slot's M-number including<br>First 1 word is adapter's number, if M9386, then 0x9386                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1110(4368)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Number of expansion slot                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1113(4371)                                                                                | Read                                                                                                                                                                                                                                                          | upto 33word | Expansion slot Module Id.<br>First 1 word is adapter's product code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x1119(4377)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | High 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(M-Bus)</th></tr><tr><td>0x00 : No Error<br/>0x01 : Error Dip Switch<br/>0x40 : Error CRC LRC<br/>0x80 : Error Watchdog</td><td>0x01 : Init State<br/>0x02 : Idle State<br/>0x03 : Run State<br/>0x04 : Stop State<br/>0x05 : Fault State<br/>0x06 : Reset State<br/>0x07 : CRC Error State<br/>0x08 : PauseState<br/>0x09 : Master Fault State<br/>0x80* : At Hot swap mode<br/>expansion module error</td></tr></table> | ModBus Status | Internal bus status(M-Bus) | 0x00 : No Error<br>0x01 : Error Dip Switch<br>0x40 : Error CRC LRC<br>0x80 : Error Watchdog | 0x01 : Init State<br>0x02 : Idle State<br>0x03 : Run State<br>0x04 : Stop State<br>0x05 : Fault State<br>0x06 : Reset State<br>0x07 : CRC Error State<br>0x08 : PauseState<br>0x09 : Master Fault State<br>0x80* : At Hot swap mode<br>expansion module error |
| ModBus Status                                                                               | Internal bus status(M-Bus)                                                                                                                                                                                                                                    |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x00 : No Error<br>0x01 : Error Dip Switch<br>0x40 : Error CRC LRC<br>0x80 : Error Watchdog | 0x01 : Init State<br>0x02 : Idle State<br>0x03 : Run State<br>0x04 : Stop State<br>0x05 : Fault State<br>0x06 : Reset State<br>0x07 : CRC Error State<br>0x08 : PauseState<br>0x09 : Master Fault State<br>0x80* : At Hot swap mode<br>expansion module error |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |
| 0x111D(4381)                                                                                | Read                                                                                                                                                                                                                                                          | 1 word      | Adapter M-Series Revision.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |               |                            |                                                                                             |                                                                                                                                                                                                                                                               |

\* After the system is reset, the new "Set Value" action is applied.

\*\*If The Hot Swap Status is enabled, the flag bit is raised when the module is removed.

## 4.5.4. 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                                                                                                                                                                                                                                                                  |
|----------------|------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| + 0x02(+2) **  | Read       | 1 word             | Input start register address of input image word this slot.                                                                                                                                                                                                                  |
| + 0x03(+3) **  | Read       | 1 word             | Input word's bit offset of input image word this slot.                                                                                                                                                                                                                       |
| + 0x04(+4) **  | Read       | 1 word             | Output start register address of output image word this slot.                                                                                                                                                                                                                |
| + 0x05(+5) **  | Read       | 1 word             | Output word's bit offset of output image word this slot.                                                                                                                                                                                                                     |
| + 0x06(+6) **  | Read       | 1 word             | Input bit start address of input image bit this slot.                                                                                                                                                                                                                        |
| + 0x07(+7) **  | Read       | 1 word             | Output bit start address of output image bit this slot.                                                                                                                                                                                                                      |
| + 0x08(+8) **  | Read       | 1 word             | Size of input bit this slot                                                                                                                                                                                                                                                  |
| + 0x09(+9) **  | Read       | 1 word             | Size of output bit this slot                                                                                                                                                                                                                                                 |
| + 0x0A(+10)**  | Read       | n word             | Read input data this slot                                                                                                                                                                                                                                                    |
| + 0x0B(+11)**  | Read/Write | n word             | Read/write output data this slot                                                                                                                                                                                                                                             |
| + 0x0E(+14)    | Read       | 1 word             | M-number, if M-1238, returns 0x1238                                                                                                                                                                                                                                          |
| + 0x0F(+15)    | Read       | String upto 72byte | First 1 word is length of valid character string.<br>If M12DF, returns<br>"00 23 4D 31 32 44 46 2C 20 31 36 44 49 2C 20 32 34 56 64 63 2C 20 55 6E 69 76 65 72 73 61 6C 20 31 38 "<br>Valid character size = 0x001E =30 characters,<br>"M12DF, 16DI, 24Vdc, Universal 18RTB" |
| + 0x10(+16)    | Read       | 1 word             | Size of configuration parameter byte                                                                                                                                                                                                                                         |
| + 0x11(+17)**  | Read/Write | n word             | Read/write Configuration parameter data, up to 8byte. Refer to A.2 ***                                                                                                                                                                                                       |
| + 0x17(+23)    | Read       | 2word              | Firmware Revision<br>ex) 0x00010010 (Major revision 1/Minor revision 16, Rev 1.016)                                                                                                                                                                                          |
| + 0x19(+25)    | Read       | 2word              | Firmware release date.                                                                                                                                                                                                                                                       |

\* 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.

## 4.6. Supported MODBUS Function Codes

MODBUS Reference Documents

<http://www.modbus.org>

MODBUS Tools

<http://www.modbustools.com>, modbus poll

<http://www.win-tech.com>, modscan32