**ZBANA-MODBUS Specification**

*Rev 0.3*

*Last Updated, Sep/30/2019*

*Scanjet Macron*

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Revision History

|  |  |
| --- | --- |
| Rev 0.3 | * Default Port Gain is changed from 0.9965 to 0.9985 (Section 5.4) * Added EEPROM Reset Register (Section 5.7) * Added firmware version input register (Section 5.8) * Added running mode holding register (Section 5.9) * Added Special Condition on Address Selector 15 (Section 4) |

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1. Objective

This document aims at describing MODBUS protocol of ZBANA board.

1. Introduction

ZBANA-MODBUS acts as MODBUS RTU slave. ZBANA-MODBUS accepts requests from MODBUS RTU master and responds appropriately as specified in MODBUS RTU standard literatures and this document.

1. Communication Parameters

ZBANA-MODBUS board provides industry standard RS485 interface to communicate with MODBUS RTU masters. The communication parameters used by ZBANA-MODBUS are as follows.

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Note |
| Baud Rate | 38400 BPS | - |
| Parity | No parity | - |
| Stop Bit | 1 stop bit | - |
| Data | 8 bit | - |

1. MODBUS RTU Slave Address

MODBUS RTU Slave address is set by adjusting address selector rotary switch on the board. MODBUS RTU Address is decided using the following formula.

***MODBUS RTU Address = 10 + Rotary Switch Value***

For example, if you set the rotary switch to 5, the MODBUS RTU address becomes 15.

***Rotary Switch Address 15, that is, MODBUS address 25, isn’t available for normal use. The rotary switch position is used to force the board to enter bootloader mode so that the board can be recovered from corrupted application firmware.***

1. MODBUS Registers

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Register Type | Address | Description | Multiply factor | Offset |
| Coil | 1000 | PORT-01 Power | - | - |
| Coil | 1001 | PORT-02 Power | - | - |
| Coil | 1002 | PORT-03 Power | - | - |
| Coil | 1003 | PORT-04 Power | - | - |
| Coil | 1004 | PORT-05 Power | - | - |
| Coil | 1005 | PORT-06 Power | - | - |
| Coil | 1006 | PORT-07 Power | - | - |
| Coil | 1007 | PORT-08 Power | - | - |
| Coil | 1008 | PORT-09 Power | - | - |
| Coil | 1009 | PORT-10 Power | - | - |
| Coil | 1010 | PORT-11 Power | - | - |
| Coil | 1011 | PORT-12 Power | - | - |
| Discrete Input | 1000 | PORT-01 Status | - | - |
| Discrete Input | 1001 | PORT-02 Status | - | - |
| Discrete Input | 1002 | PORT-03 Status | - | - |
| Discrete Input | 1003 | PORT-04 Status | - | - |
| Discrete Input | 1004 | PORT-05 Status | - | - |
| Discrete Input | 1005 | PORT-06 Status | - | - |
| Discrete Input | 1006 | PORT-07 Status | - | - |
| Discrete Input | 1007 | PORT-08 Status | - | - |
| Discrete Input | 1008 | PORT-09 Status | - | - |
| Discrete Input | 1009 | PORT-10 Status | - | - |
| Discrete Input | 1010 | PORT-11 Status | - | - |
| Discrete Input | 1011 | PORT-12 Status | - | - |
| Input | 1000 | PORT-01 4-20ma Input | 1000 | - |
| Input | 1001 | PORT-02 4-20ma Input | 1000 | - |
| Input | 1002 | PORT-03 4-20ma Input | 1000 | - |
| Input | 1003 | PORT-04 4-20ma Input | 1000 | - |
| Input | 1004 | PORT-05 4-20ma Input | 1000 | - |
| Input | 1005 | PORT-06 4-20ma Input | 1000 | - |
| Input | 1006 | PORT-07 4-20ma Input | 1000 | - |
| Input | 1007 | PORT-08 4-20ma Input | 1000 | - |
| Input | 1008 | PORT-09 4-20ma Input | 1000 | - |
| Input | 1009 | PORT-10 4-20ma Input | 1000 | - |
| Input | 1010 | PORT-11 4-20ma Input | 1000 | - |
| Input | 1011 | PORT-12 4-20ma Input | 1000 | - |
| Holding | 1000 | PORT-01 Gain | 10000 | - |
| Holding | 1001 | PORT-02 Gain | 10000 | - |
| Holding | 1002 | PORT-03 Gain | 10000 | - |
| Holding | 1003 | PORT-04 Gain | 10000 | - |
| Holding | 1004 | PORT-05 Gain | 10000 | - |
| Holding | 1005 | PORT-06 Gain | 10000 | - |
| Holding | 1006 | PORT-07 Gain | 10000 | - |
| Holding | 1007 | PORT-08 Gain | 10000 | - |
| Holding | 1008 | PORT-09 Gain | 10000 | - |
| Holding | 1009 | PORT-10 Gain | 10000 | - |
| Holding | 1010 | PORT-11 Gain | 10000 | - |
| Holding | 1011 | PORT-12 Gain | 10000 | - |
| Holding | 1012 | PORT-01 Offset | 10000 | 20000 |
| Holding | 1013 | PORT-02 Offset | 10000 | 20000 |
| Holding | 1014 | PORT-03 Offset | 10000 | 20000 |
| Holding | 1015 | PORT-04 Offset | 10000 | 20000 |
| Holding | 1016 | PORT-05 Offset | 10000 | 20000 |
| Holding | 1017 | PORT-06 Offset | 10000 | 20000 |
| Holding | 1018 | PORT-07 Offset | 10000 | 20000 |
| Holding | 1019 | PORT-08 Offset | 10000 | 20000 |
| Holding | 1020 | PORT-09 Offset | 10000 | 20000 |
| Holding | 1021 | PORT-10 Offset | 10000 | 20000 |
| Holding | 1022 | PORT-11 Offset | 10000 | 20000 |
| Holding | 1023 | PORT-12 Offset | 10000 | 20000 |
| Holding | 1024 | PORT-01 Filter | 10000 | - |
| Holding | 1025 | PORT-02 Filter | 10000 | - |
| Holding | 1026 | PORT-03 Filter | 10000 | - |
| Holding | 1027 | PORT-04 Filter | 10000 | - |
| Holding | 1028 | PORT-05 Filter | 10000 | - |
| Holding | 1029 | PORT-06 Filter | 10000 | - |
| Holding | 1030 | PORT-07 Filter | 10000 | - |
| Holding | 1031 | PORT-08 Filter | 10000 | - |
| Holding | 1032 | PORT-09 Filter | 10000 | - |
| Holding | 1033 | PORT-10 Filter | 10000 | - |
| Holding | 1034 | PORT-11 Filter | 10000 | - |
| Holding | 1035 | PORT-12 Filter | 10000 | - |
| Coil | 40000 | Reset EEPROM content | - | - |
| Holding | 20000 | UART-0 Response Delay | - | - |
| Holding | 20001 | UART-1 Response Delay | - | - |
| Input | 30000 | Firmware Version |  |  |
| Holding | 32000 | Running Mode |  |  |

**All the 16 bit registers are in big-endian format, that is, high byte comes first.**

* 1. Port Power

MODBUS masters can power on/off individual 4-20ma port using this port power registers.

MODBUS Coil register is used to get/set individual port status. Logic High (1) means the port is powered. Logic Low (0) means the port is not powered.

Power of each port can be adjusted by writing to this register and the change is applied immediately. Also the new power status value is saved to internal EEPROM so the change is preserved across power cycle. The default EEPROM content for port power status is Logic High (1), which is power on.

* 1. Port Status

MODBUS masters can get individual port status of the board. MODBUS input register is used to represent status of individual port and Logic High (1) indicates that port status is OK. Logic Low (0) indicates that port status is not OK.

As of this writing, there is no mechanism to detect any port hard failure and thus, port status is always OK.

* 1. 4-20mA input

Measured milliampere input is calculated using the following formula.

***result = previous-result + (input \* gain – offset – previous-result) / (filter + 1.0))   
  
Where,  
Input is 4-20ma input  
previous-result is previously calculated 4-20mA input result and its default value is 0  
gain is between 0.98 and 1.02  
offset is between -2.0 and 2.0  
filter is between 0.0 and 2.0***

MODBUS input register is used to represent 4-20mA input and its content is 1000 times the calculated milliampere input, that is,

***MODBUS input register = calculated input (in mA) \* 1000***.

For example, 15.643mA input is 15643 in the input register.

* 1. Gain

Gain is used to calculate measured milliampere input of a port. Its range is between 0.98 and 1.02 inclusive. The default value is 0.9985.

MODBUS holding register is used to get/set gain value of each port. The value in the holding register is calculated using multiplication factor 10000. So 0.9965 is represented as 9965.

Gain of each port can be adjusted by writing to this register and the change is applied immediately. Also the new gain value is saved to internal EEPROM so the change is preserved across power cycle.

* 1. Offset

Offset is used to calculate measured milliampere input of a port. Its range is between -2.0 and 2.0 inclusive. The system default value is 0.0.

MODBUS holding register is used to get/set offset value of each port. Its content is calculated using the following formula.

***Register value = offset value \* 10000 + 20000***

So -2.0 is 0 in the holding register and 2.0 is 40000 in the holding register.

Offset of each port can be adjusted by writing to this register and the change is applied immediately. Also the new offset value is saved to internal EEPROM so the change is preserved across power cycle.

* 1. Filter

Filter is used to calculate measured milliampere input of a port. Its range is between 0.0 and 2.0 inclusive. Its default value is 1.0

MODBUS holding register is used to get/set filter value of each port. Its content is calculated using the following formula.

***Register value = filter value \* 10000***

So 0.0 is 0 in the holding register and 2.0 is 20000 in the holding register.

Filter of each port can be adjusted by writing to this register and the change is applied immediately. Unlike gain and offset, the new filter value is not saved to internal EEPROM. So after next power cycle, filter value is reset to the default value.

* 1. Reset EEPROM content

By writing Logic High (1) to this MODBUS coil register, MODBUS masters can reset the EEPROM content to factory default. The change is in effect immediately and all the EEPROM contents are set to factory default.

* 1. Firmware Version

Firmware version reflects current firmware version installed on the board.

Version number 234 means version “2.34”.

* 1. Running Mode

Running Mode holding register reflects current running mode of the board. There are two running modes defined. The following modes are defined.

|  |  |
| --- | --- |
| Mode | Description |
| 0 | Bootloader Mode  Bootloader mode is used to upgrade firmware. |
| 1 | Application Mode  Application Mode is normal mode and application firmware is run in this mode |

By writing to running mode register, users can change running mode.

* 1. Response Delay

Response Delay is a feature to delay the transmission of actual MODBUS response for a specified time in millisecond after handling of a MODBUS request. The response delay value ranges from 0ms to 5000ms. The default value of response delay is 0ms.

