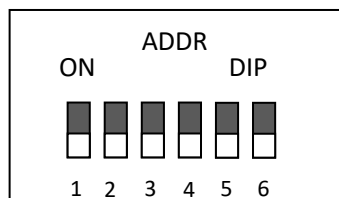


## 1 Physical interface and data format

### 1.1 The electrical standard of physical communication interface

The communication between master and slave node using Modbus (RS485), with RTU mode. Support communication address range:1-63(0x01-0x3F)。

#### 1.1.1 Address setting:



The switch 1 of ADDR switch corresponding to the first 1 bit from right end.

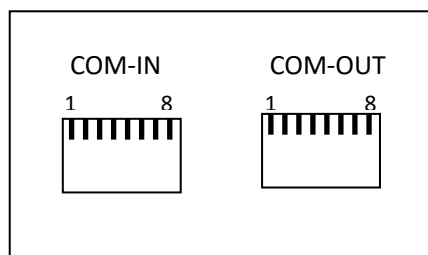
For example: Addr1~3:

“0 0 0 0 0 1” indicate to “0X01”;

“0 0 0 0 1 0” indicate to “0X02”;

“0 0 0 0 1 1” indicate to “0X03”;

#### 1.1.2 Communicate port description in below pictures:



PIN1	485-A
PIN2	485-B

### 1.2 Byte frame format

Each byte of data format as below:

Start bit: 1bit	Data bit: 8bits (Direction from left to right: LSB->MSB)	Stop bit:1bit
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Using asynchronous mode communication, byte frame format is:

1pc of start bit, 8pcs of data bits (information byte), not to verify, 1pc stop bit. Total 10 bits.

Normal Parity :none    Data bits.:8bits    Stop bits:1 bit    Flow control: LSB->MSB

### 1.3 Data transmission rate

Data transmission rate can be determined according to the different system, default using baud rate 9600.

### 1.4 Data frames

The data frames in the communication process is defined as below:

#### 1.4.1 The master node sends format:

Slave Address	Function	Starting Address(High)	Starting Address(Low)	No. of Points(High)	No. of Points(Low)	CRC (Low)	CRC (High)
8bit	8bit	8bit	8bit	8bit	8bit	8bit	8bit

The fields are described as below:

**Slave Address:** 1byte, it is slave node address which communicates by the master node.

Each slave node receives to do address recognition, if it does not respond on non-node packet, will discard it directly.

**Function:** 1byte, indicates communication requirements.

**Starting Address:** Start address contains two bytes, respectively as Starting Address(High) and Starting Address(Low), the actual value correspond to register address, details please check Chapter7.

**No. of Points (To read numbers):** To indicate the number of register which obtain from the slave node. No. of Points contains two bytes, respectively as No. of Points (High) and No. of Points (Low) . The registers be read should be continuous, and if the registers be read is not continuous, it should be segmented to obtain.

**CRC:** CRC field contains two bytes, CRC(Low) and CRC(High).

Note: CRC use : $1+X^2+X^{15}+X^{16}$

#### 1.4.2 Response format from slave node:

Slave Address	Function	Byte Count	Data_1: Register(High)	Data_1: Register(Low)	Data_n: Register(High)	Data_n: Register(Low)	CRC (Low )	CRC (High)
8bit	8bit	8bit	8bit	8bit	8bit	8bit	8bit	8bit

The fields are described as below:

**Slave Address:** 1byte, it is slave node address which communicates by the master node.

Each slave node receives to do address recognition, if it does not respond on non-node packet, will

discard it directly.

**Function:** 1byte, respond to the communication requirement of the host device, in accord with the host device.

**Byte Count:** 1byte, to indicate the data length, the data is from slave node back to the master node, according low to high order, details please check Chapter 7.

**Data\_1 ~ Data\_n(Data):** To indicate the data from slave node back to the master node, the “n” of “Data\_n” is decimal value of “Byte Count”.

**CRC:** CRC field contains two bytes, CRC(High) and CRC(Low).

## 1.5 Exception response

Except for broadcast messages, when a master device sends a query to a slave device it expects a normal response. One of four possible events can occur from the master’s query:

- If the slave device receives the query without a communication error, and can handle the query normally, it returns a normal response.
- If the slave does not receive the query due to a communication error, no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave receives the query, but detects a communication error (parity, LRC or CRC), no response is returned. The master program will eventually process a timeout condition for the query.
- If the slave receives the query without a communication error, but cannot handle it (for example, if the request is to read a non-existent coil or register), the slave will return an exception response informing the master of the nature of the error.

Exception response command format is as below:

Slave Address	Function	Data	CRC(Low)	CRC(High)
8bit	8bit	8bit	8bit	8bit

Slave node response message field as below:

**Slave Address:** 1byte, it is slave node address which communicates by the master node.

Each slave node receives to do address recognition, if it does not respond on non-node packet, will discard it directly.

**Function:** 1byte, respond to the communication requirement of the host device, in accord with the host device. For an exception response, the slave returns a code that is equivalent to

the original function code with its most-significant bit set to a logic 1.

**Data:** 1byte, indicate abnormal code back from node. Defined as below:

0x01: The function code received in the query is not an allowable action for the slave. If a Poll Program Complete command was issued, this code indicates that no program function preceded it.

0x02: The data address received in the query is not an allowable address for the slave.

0x03: A value contained in the query data field is not an allowable value for the slave.

0x04: An unrecoverable error occurred while the slave was attempting to perform the requested action.

0x05: The slave has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master. The master can next issue a Poll Program Complete message to determine if processing is completed.

0x06: The slave is engaged in processing a long-duration program command. The master should retransmit the message later when the slave is free.

0x07: The slave cannot perform the program function received in the query.

0x08: The slave attempted to read extended memory, but detected verify error in the memory. The master can retry the request, but service may be required on the slave device.

0xFF: Other undefined error.

All orders which defined as reserved data bytes are uniform regulations to 0xFF.

## 1.6 Byte sequence

Multi-byte data transmitted sequence on the BUS is decided by system. When send information on standard Modbus, each character or byte transmitted in the order from left to right (or from low to high).

# 2 Communication process

Communications using master-slave technique. Every communication must be initiated by the master node, and the slave node must be in a passive state as well.

## 2.1 Query command communication process

Query command communication process as below:

Master node

Slave node

Master node send query command data frame



Slave node response information data frame



【Step 1】 Master node→ Master node send query command data frame to slave node. The master node enters into waiting state after sending data. If the response is not received from slave node, or received an incorrect response over T1 (100ms), it could consider this communication process fail.

【Step 2】 Slave node→ When slave node received data frame from master node, the slave node to do judgment on the data frame. If the address of data frame is accord with node address, then the slave node will report to master node after checking the data frame by CRC (see 4.4). If the slave node address is not matched, it will not respond and continue to wait for the next time communication from master node.

### 3 Protocol functions

#### Function Definition

Status inquiry: Master node to get state of slave node through query command.

### 4 Information format

4.1 Read register 40009-40010:

Remark: Slave device address 0x02, Function code 0x03

Slave Address	Function	Starting Address(High)	Starting Address(Low)	No. of Points(High)	No. of Points(Low)	CRC(Low)	CRC(High)
0x02	0x03	0x00	0x08	0x00	0x02	0X45	0XFA

4.2 Read register 40009-40010 response:

Remark: Slave device address 0x02, Function code 0x03, 40009 register value is 343,40010 Register value is 274

Slave Address	Function	Byte Count	Data_1: Register(High)	Data_1: Register(Low)	Data_n: Register(High)	Data_n: Register(Low)	CRC (Low)	CRC (High)
0x02	0x03	0x04	0x01	0x57	0x01	0x12	-	-