j	MODBUS communication frame format			
	Department	R&D	Document Category	Protocol
	Date	2015/2/15	Model	HT9922 V50

The communication protocol adopts MODBUS format, and the mode adopts RTU. That is 3.5 stop bits as start and stop bits. The time between each byte of data does not exceed 1.5 stop bits.

Default address 0x01

A. Register access function code

Read register code

1. 0x03 - read the save register instruction, the save register is used to save the instrument setting parameters.
2. 0x04 - read the input register instructions for storing the test results of the instrument.

Request a frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x04/0x03	1 byte
The start register address		2 bytes
Number of registers		2 bytes
CRC check code		2 bytes

Normal response frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x04/0x03	1 byte
The number of bytes		1 byte
Input registers		n bytes
CRC check code		2 bytes

Exception response frame		
Address code	0x01~0xFF	1 byte
Exception code	0x84/0x83	1 byte
Error code	0x01-0x05	1 byte

CRC check code		2 bytes

*Error codes are detailed in the error code table.

Write register code

1. 0x06 write a single register code

Request a frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x06	1 byte
Register address		2 bytes
Register value		2 bytes
CRC check code		2 bytes

Normal response frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x06	1 byte
Register address		2 bytes
Register value		2 bytes
CRC check code		2 bytes

Exception response frame		
Address code	0x01~0xFF	1 byte
Exception code	0x86	1 byte
Error code	0x01-0x04	1 byte
CRC check code		2 bytes

2. 0x10 write multiple registers

Request a frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x10	1 byte
The start register address		2 bytes
Number of registers		2 bytes
The number of bytes		1 byte
Register value		N bytes
CRC check code		2 bytes

Normal response frame

Address code	0x01~0xFF	1 byte
Instruction code	0x10	1 byte
The start address		2 bytes
Number of registers		2 bytes
CRC check code		2 bytes

Exception response frame		
Address code	0x01~0xFF	1 byte
Exception code	0x90	1 byte
Error code	0x01-0x05	1 byte
CRC check digits		2 bytes

*Error codes are detailed in the error code table.

3. Registers (16 bits per register, 2 bytes)

The hold register is used to store instrument-related setup parameters.

Hold register address 0x4000			
address	**function**	**byte**	**value**
0x4000	The current test group number (M1, M2, M3).	2	0x0001: Group M1
			0x0002: Group M2
			0x0003: Group M3
			0x0004: Group M4
			0x0005: Group M5
			0x0006: Group M6
0x4001	Test mode (AC, DC, IR).	2	0x0001: AC test mode
			0x0002: DC test mode
			0x0003: IR test mode
0x4002	Set the new address of the instrument	2	1~255
0x4003	Sets the	2	0x0001:9600

	instrument baud rate		0x0002:19200
			0x0003:38400
0x4004	Start/stop the test	2	0x0000: Stop (reset).
			0x0001: Start
0x4010	AC output voltage value	2	A two-byte integer number that converts a hexadecimal number into decimal number/1000 unit: kV
			Value range: 0.010kV to 5.000kV
0x4011	AC upper limit current value	2	Upper limit current value = read data (decimal)/100 unit: mA
			Value range: 0.01mA to 12.00mA
0x4012	AC lower limit current value	2	Lower limit current value = read data (decimal)./ 100 unit: mA
			Value range: 0.00mA to 12.00mA
0x4013	AC rise time	2	Time = Read data (decimal)/10
			Unit:S
			Value range: 0.1S~999.9S
0x4014	AC test time	2	Time = Read data (decimal)/10
			Unit:S
			Value range: 0.0S~999.9S
0x4015	AC test frequency	2	0x0001: 50Hz
			0x0002: 60Hz
0x4016	AC arc sensitivity	2	0~9 (0 means turn off this function). 0x0001: Off
0x4017	AC connection test enablement	2	0x0001: Off
			0x0002: Open - All
			0x0003: Open - Qualified
0x4020	DC output voltage value	2	A two-byte integer number that converts a hexadecimal number into decimal number/1000 unit: Kv
			Value range: 0.010kV to 5.000kV
0x4021	The upper limit DC current value	2	Upper limit current value = read data (decimal)/ 100 unit: mA
			Value range: 0.01mA to 6.00mA

0x4022	The lower limit DC current value	2	Lower limit current value = read data (decimal)/1000 unit: mA
			Value range: 0.01mA to 6.00mA
0x4023	DC rise time	2	Time = Read data (decimal)/10
			Unit:S
			Value range: 0.1S~999.9S
0x4024	DC test time	2	Time = Read data (decimal)/10
			Unit:S
			Value range: 0.0S~999.9S
0x4025	DC arc sensitivity	2	0~9 (0 means turn off this function)
0x4026	DC connection test enabled	2	0x0001: Off
			0x0002: Open - All
			0x0003: Open - Qualified
0x4030	Insulation resistance output voltage value	2	A two-byte integer number that converts a hexadecimal number into decimal number/1000 unit: kV
			Value range: 0.500kV to 1.000kV
0x4031	Insulation resistance range selection	2	1:100G
			2:1G
			3:100M
			4:10M
			5:1M
0x4032	The insulation resistance upper limit comparator enabled	2	1:OFF
			2:ON
0x4033	The insulation resistance upper limit is high	2	A four-byte floating-point number
0x4034	The insulation resistance upper limit is low	2	Value range: 200kΩ~99G
0x4035	The insulation resistance lower limit is high	2	A four-byte floating-point number
0x4036	The insulation resistance lower limit is low	2	Value range: 200kΩ~99G

0x4037	Insulation resistance wait time	2	Time = Read data (decimal)/10
			Unit:S
			Value range: 0.4S~999.9S
			Time = Read data (decimal)/10
0x4038	Insulation resistance test time	2	Unit:S
			Value range: 0.0S~999.9S
0x4039	Insulation resistance connection test enabled	2	0x0001: Off
			0x0002: Open - All
			0x0003: Open - Qualified
0x4100	Instrument version number	12	Instrument version number

*Setting parameter beyond the register will cause a register operation error.
Setting in auto range mode also causes register operation error.

B. Input registers are used to store test results

Input register address 0x3000			
address	function	byte	value
0x3000	Test status	2	0x0001: Wait for the test 0x0002: Testing 0x0003: Wait for the reset
0x3001	The first test status	2	0x0001: Wait for the test 0x0002: The test is complete
0x3002	The first test status group number	2	Range 1 to 6
0x3003	The first test mode	2	0x0001:AC 0x0002:DC 0x0003:IR
0x3004	The first voltage readback value	2	A two-byte integer number that converts a hexadecimal number into decimal number unit:V

0x3005	The first test value is high	2	A four-byte floating-point number
0x3006	The first test value is low	2	
0x3007	First test comparison results	2	0x0001:PASS 0x0002:FAIL
0x3008	The second test status	2	0x0001: Wait for the test 0x0002: The test is complete
0x3009	The second test status group number	2	Range 1 to 6
0x300A	The second test mode	2	0x0001:AC 0x0002: DC 0x0003:IR
0x300B	The second voltage readback value	2	A two-byte integer number that converts a hexadecimal number into decimal number unit V
0x300C	The second test value is high	2	A four-byte floating-point number
0x300D	The second test value is low	2	
0x300E	The second test comparison results	2	0x0001:PASS 0x0002:FAIL
0x300F	Third test status	2	0x0001: Wait for the test 0x0002: The test is complete
0x3010	The third test status group number	2	Range 1 to 6
0x3011	The third test mode	2	0x0001:AC 0x0002:DC 0x0003:IR

0x3012	The third voltage readback value	2	A two-byte integer number that converts a hexadecimal number into decimal number unit V
0x3013	The third test value is high	2	A four-byte floating-point number
0x3014	The third test value is low	2	
0x3015	The third test compares the results	2	0x0001: PASS 0x0002: FAIL

B. Orders

1. Start the test instruction

Request a frame		
Address code	0x00~0xFF	1 byte
Instruction code	0x65	1 byte
CRC check code		2 bytes

Normal response frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x65	1 byte
CRC check digits		2 bytes

Exception response frame		
Address code	0x01~0xFF	1 byte
Exception code	0xE5	1 byte
Error code	0x01-0x05	1 byte
CRC check code		2 bytes

2.Stop (reset) the test

The instrument abandons the current measurement and waits for the reset. After the reset, the instrument enters the waiting-for-measurement state.

If the instrument test is successful, it will automatically enter the state of waiting for reset.

Request a frame		
Address code	0x00~0xFF	1 byte
Instruction code	0x66	1 byte
CRC check code		2 bytes

Normal response frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x66	1 byte
CRC check code		2 bytes

Exception response frame		
Address code	0x01~0xFF	1 byte
Exception code	0xE6	1 byte
Error code	0x01-0x05	1 byte
CRC check code		2 bytes

3. Instrument version number query code

Request a frame		
Address code	0x00~0xFF	1 byte
Instruction code	0x67	1 byte
CRC check code		2 bytes

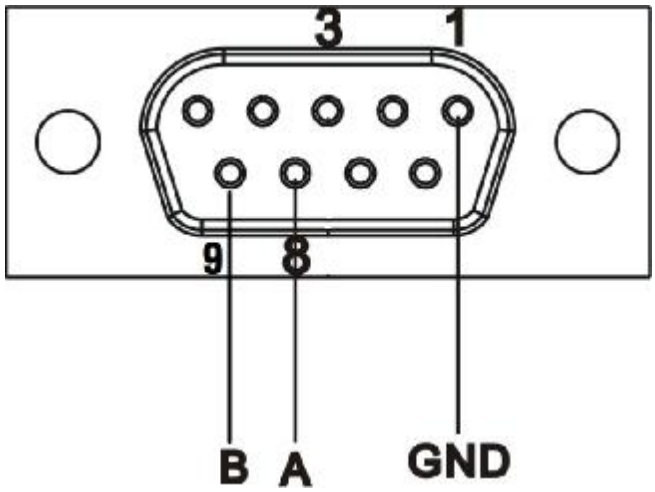
Normal response frame		
Address code	0x01~0xFF	1 byte
Instruction code	0x67	1 byte
CRC check code		2 bytes

Exception response frame		
Address code	0x01~0xFF	1 byte
Exception code	0xE7	1 byte
Error code	0x01-0x05	1 byte
CRC check code		2 bytes

C. Error code table

Error code	
0x01	The instruction code is incorrect
0x02	Address access error
0x03	The number of register accesses is incorrect
0x04	Register operation error
0x05	**CRC check error**

D. Wiring diagram



E. Appendix

1. Introduction to 4-byte floating-point numbers.

For example, in insulation resistance test mode, set the upper limit of insulation resistance value 100GΩ, and first define a union univalue in C:

union univalue

{

unsigned int int type[2];

float floattype;

};

In insulation resistance test mode, the resistance unit is MΩ, and the upper limit current value is set to 100GΩ, so floattype = 100000 and then read the value of the unsigned integer array

inttype[1] = 0x5000；

inttype[0] = 0x47C3；

Place the read four-byte floating-point value in the insulation resistance upper limit register high position 0x5000

Place the read four-byte floating-point value in the insulation resistance upper limit register Low position 0x47C3