SPS6010HP Programmable Power Supply Communication Protocol V1.0

I. Protocol Introduction

It adopts RS232, RS485 or Bluetooth serial port transmission interface, and the communication protocol is MODBUS-RTU protocol. This product only supports function codes 0x03, 0x06, and 0x10.

II. Communication Protocol Description

The information transmission is asynchronous. The Modbus-RTU mode takes an 11-bit byte as a unit.

Word Format (Serial Data):	10-bit binary
Start Bit:	1 bit
Data Bit:	8 bits
Parity Bit:	None
Stop Bit:	1 bit

Data Frame Structure:

Data Frame Interval:	Address Code:	Function Code:	Data Area:	CRC Check:
More than 3.5 bytes	1byte	1byte	N bytes	2 bytes

Before sending data, it is required that the data bus be stationary, that is, the time without data transmission is greater than 3.5 (for example, when the baud rate is 9600, it is 5ms). The message transmission must start with a pause interval of at least 3.5 byte times. The entire message frame must be transmitted as a continuous data stream. If there is a pause time of more than 3.5 byte times before the frame is completed, the receiving device will refresh the incomplete message and assume that the next byte is the address field of a new message. Similarly, if a new message starts within less than 3.5 character times after the previous message, the receiving device will consider it a continuation of the previous message.

1.1 Address Code

The address code is the first byte (8 bits) of each communication information frame, ranging from 1 to 255. This byte indicates that the slave device with the address set by the user will receive the information sent by the master device. Each slave device must have a unique address code, and only the slave device that matches the address code can respond and send back information. When the slave device sends back information, the returned data all start with their respective address codes. The address code sent by the master device indicates the address of the slave device to which the data will be sent, and the address code returned by the slave device indicates the address of the slave device that sends back the data. The corresponding address code indicates where the information comes from.

1.2 Function Code

The function code is the second byte transmitted in each communication information frame. The function codes that can be defined by the ModBus communication protocol range from 1 to 127. As a request sent by the master device, the function code is used to tell the slave device what action to perform. As a response from the slave device, the function code returned by the slave device is the same as the function code sent by the master device, indicating that the slave device has responded to the master device and has performed the relevant operation. This device only supports function codes 0x03, 0x06, and 0x10.

Function Code	Definition	Operation (Binary)
0x03	Read Register Data	Read the data of one or more registers
0x06	Write Single Register	Write a set of binary data into a single register
0x10	Write Multiple Registers	Write multiple sets of binary data into multiple registers

1.3 Data Area

The data area includes what information needs to be returned by the slave device or what action to perform. This information can be data (such as digital input/output, analog input/output, registers, etc.), reference addresses, etc. For example, when the master device uses function code 03 to tell the slave device to return the value of a register (including the starting address of the register to be read and the length of the register to be read), the returned data includes the data length of the register and the data content.

0x03 Read Function Master Device Format

Address Code	Function Code	Register Starting Address	Number of Register Addresses n (1 - 32)	CRC Check Code
1byte	1byte	2byte	2byte	2byte

0x03 Read Function Slave Device Return Format

Address Code	Function Code	Number of Returned Bytes 2 * n	Register Data	CRC Check Code
1byte	1byte	1byte	2*n byte	2byte

0x06 Write Single Register Function Master Device Format

Address Code	Function Code	Register Address	Register Data	CRC Check Code
1byte	1byte	2byte	2byte	2byte

0x06 Write Single Register Function Slave Device Return Format

Address Code	Function Code	Register Address	Register Data	CRC Check Code
1byte	1byte	2byte	2byte	2byte

0x10 Write Function Master Device Format

Address Code	Function Code	Register Starting Address	Number of Register Addresses n (1 - 32)	Number of Written Bytes 2 * n	Register Data	CRC Check Code
1byte	1byte	2byte	2byte	1byte	2*n byte	2byte

0x10 Write Function Slave Device Return Format

Address Code	Function Code	Register Starting Address	Number of Register Addresses n (1 - 32)	CRC Check Code
1byte	1byte	2byte	2byte	2byte

Protocol Register Introduction (Data in a single register address is a two-byte data type)

Name	Description	Byte Number	Decimal Point	Unit	Read/Write	Register Address
U-SET	Voltage Setting	2	2	V	R/W	0000H
I-SET	Current Setting	2	3	A	R/W	0001H
UOUT	Output Voltage Display Value	2	2	V	R	0002H
IOUT	Output Current Display Value	2	3	A	R	0003H
POWER	Output Power Display Value	2	2	W	R	0004H
UIN	Input Voltage Display Value	2	2	V	R	0005H
REMOTE	Remote Control Lock	2	0	0 - 1	R/W	0006H
ANALOG	Analog Control Status	2	0	0 - 1	R	0007H
CVCC	Constant Voltage/Constant Current Status	2	0	0 - 1	R	0008H
ONOFF	Switch Output	2	0	0 - 1	R/W	0009H
B_LED	Backlight Brightness Level	2	0	0 - 5	R/W	000AH
MODEL	Product Model	2	0	-	R	000BH
VERSON	Firmware Version Number	2	0	-	R	000CH
S-OVP	Overvoltage Protection Value	2	2	V	R/W	0052H
S-OCP	Overcurrent Protection Value	2	3	A	R/W	0053H
S-OVP EN	Overvoltage Protection Switch	2	0	0 - 1	R/W	0054H
S-OCP EN	Overcurrent Protection Switch	2	0	0 - 1	R/W	0055H
S-OVP STATUS	Overvoltage Protection Status	2	0	0 - 1	R	0056H
S-OCP STATUS	Overcurrent Protection Status	2	0	0 - 1	R	0057H
S-OTP STATUS	Overheating Protection Status	2	0	0 - 1	R	0058H
S-STATUS	System Comprehensive Status	2	0	-	R	0059H

Note 1: The read and write values of the remote control lock are 0 and 1, where 0 means unlocked and 1 means locked.

Note 2: The read values of the constant voltage/constant current status are 0 and 1, where 0 means CV status and 1 means CC status.

Note 3: The read and write values of the switch output function are 0 and 1, where 0 means off state and 1 means on state.

Note 4: The read and write range of the backlight brightness level is 0 - 5, with level 0 being the darkest and level 5 being the brightest.

Note 5: System comprehensive status: Bit 0 is the output status, Bit 1 is the remote lock status, Bit 2 is the analog control status, Bit 3 is the constant current/constant voltage status, Bit 4 is the overcurrent protection status, Bit 5 is the overvoltage protection status, and Bit 6 is the overheating protection status.

1.4 Error Check Code (CRC Check)

The master device or slave device can use the check code to determine whether the received information is correct. Due to electronic noise or other interferences, information may sometimes be incorrect during the transmission process. The error check code (CRC) can check whether there is an error in the communication data transmission between the master device and the slave device. Incorrect data can be discarded (both for sending and receiving), which improves the system's security and efficiency. The CRC (Cyclic Redundancy Code) of the MODBUS communication protocol contains 2 bytes, that is, 16-bit binary numbers. The CRC code is calculated by the sending device (master device) and placed at the end of the sending information frame. The receiving device (slave device) recalculates the CRC of the received information and compares whether the calculated CRC is consistent with the received one. If they are not consistent, it indicates an error. When sending the CRC check code, the low byte comes first and the high byte comes later.

Calculation Method of CRC Code:

1. Preset a 16-bit register to hexadecimal FFFF (that is, all 1s); this register is called the CRC register.
2. Exclusive-OR the first 8-bit binary data (that is, the first byte of the communication information frame) with the low 8 bits of the 16-bit CRC register, and put the result in the CRC register.
3. Shift the content of the CRC register one bit to the right (towards the low bit), fill the highest bit with 0, and check the shifted-out bit.
4. If the shifted-out bit is 0: Repeat step 3 (shift one bit to the right again); if the shifted-out bit is 1: Exclusive-OR the CRC register with the polynomial A001 (1010 0000 0000 0001).
5. Repeat steps 3 and 4 until 8 right shifts are completed, so that the entire 8-bit data is processed.
6. Repeat steps 2 to 5 to process the next byte of the communication information frame.
7. After all the bytes of the communication information frame are calculated according to the above steps, exchange the high and low bytes of the obtained 16-bit CRC register.
8. The content of the final CRC register is the CRC code.

III. Communication Examples

Example 1: The master device reads the output voltage and output current display values

The master device's sent message format:

Master Device Sends	Byte Number	Sent Information	Remarks
Slave Device Address	1	01	Sent to the slave device with address 01
Function Code	1	03	Read register
Register Starting Address	2	0002H	Register starting address
Number of Register Addresses	2	0002H	A total of 2 bytes
CRC Code	2	65CBH	CRC code calculated by the master device

For example, if the current display values are 05.00V and 5.000A, then the slave device's response and return message format:

Slave Device Response	Byte Number	Returned Information	Remarks
Slave Device Address	1	01	From slave device 01
Function Code	1	03	Read register
Number of Read Bytes	1	04	A total of 1 byte
Content of Register with Address 0002H	2	01F4H	Output voltage display value
Content of Register with Address 0003H	2	1388H	Output current display value
CRC Code	2	B76BH	CRC code calculated by the slave device

Example 2: The master device wants to set the voltage to 24.00V

The master device's sent message format:

Master Device Sends	Byte Number	Sent Information	Remarks
Slave Device Address	1	01H	From slave device 01
Function Code	1	06H	Write single register
Register Address	2	0000H	Register address
Content of Register with Address 0000H	2	0960H	Set output voltage value
CRC Code	2	8FB2H	CRC code calculated by the master device

The slave device's response and return message format after receiving:

Slave Device Response	Byte Number	Returned Information	Remarks
Slave Device Address	1	01H	Sent to the slave device with address 01
Function Code	1	06H	Write single register
Register Address	2	0000H	Register starting

			address
Content of Register with Address 0000H	2	0960H	Set output voltage value
CRC Code	2	8FB2H	CRC code calculated by the slave device

Example 3: The master device wants to set the voltage to 24.00V and the current to 1.500A

The master device's sent message format:

Master Device Sends	Byte Number	Sent Information	Remarks
Slave Device Address	1	01H	From slave device 01
Function Code	1	10H	Write register
Register Starting Address	2	0000H	Register starting address
Number of Register Addresses	2	0002H	A total of 2 bytes
Number of Written Bytes	1	04H	A total of 1 byte
Content of Register with Address 0000H	2	0960H	Set output voltage value
Content of Register with Address 0001H	2	05DCH	Set output current value
CRC Code	2	F2E4H	CRC code calculated by the master device

The slave device's response and return message format after receiving:

Slave Device Response	Byte Number	Returned Information	Remarks
Slave Device Address	1	01H	Sent to the slave device with address 01
Function Code	1	10H	Write register
Register Starting Address	2	0000H	Register starting address
Number of Register Addresses	2	0002H	A total of 2 bytes
CRC Code	2	41C8H	CRC code calculated by the slave device