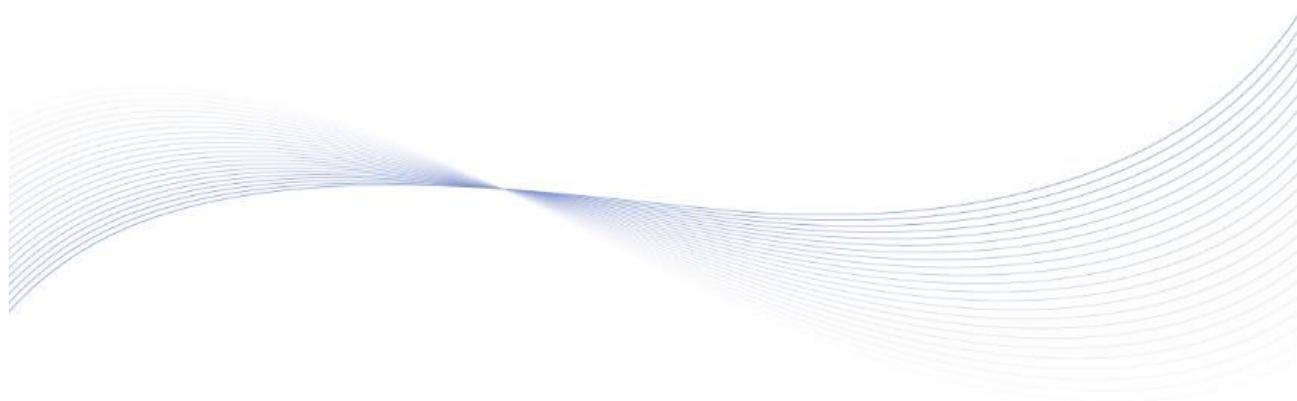


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**SmartGen**

MAKING CONTROL SMARTER

**HAT360 SERIES**  
**(HAT361/HAT361C/HAT363/HAT363C)**  
**ATS CONTROLLER**  
**COMMUNICATION PROTOCOL**



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**Table 1 Software Version**

| Date       | Version | Content           |
|------------|---------|-------------------|
| 2023-11-03 | V1.0    | Original release. |
|            |         |                   |
|            |         |                   |
|            |         |                   |

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## 1. DESCRIPTION

This protocol describes read and write command format of RS485 half-duplex serial port communication and definition of internal information data for the third-party to develop and use.

HAT360 ATS controller has one RS485 port.

The controller is used as the slave, using Modbus-RTU protocol, and does not support other protocols such as Modbus-ASCII.

Communication address: 1~254 (default: 1)

Baud rate: 2400/4800/9600/19200bps (default: 9600bps)

Start bit: 1-bit

Data bit: 8-bit

Parity bit: No/Odd/Even parity (default: no parity)

Stop bit: 1 or 2 bits (default: 1-bit)

Supported function code: 03H, 05H. Function code 03H is used for reading controller alarm, status information and various electricity data; while function code 05H is used for sending remote command.

Data check mode: CRC16.

Internal registers of controller are in the unit of "word (double bytes)".

Communication timeout period: over 200ms.

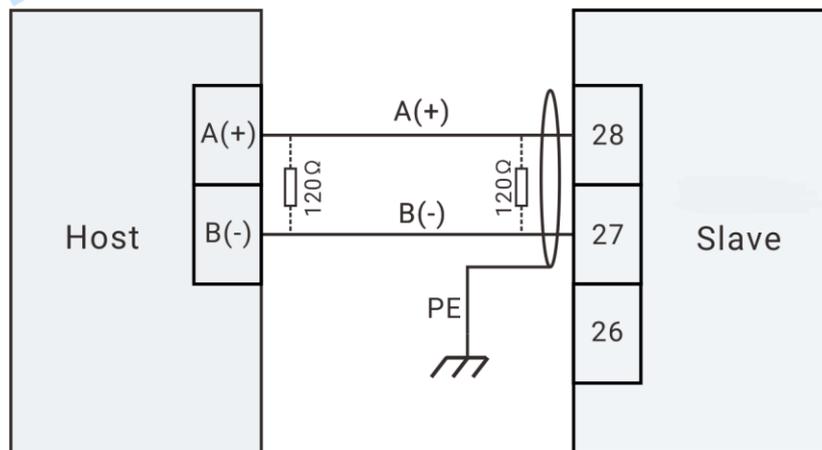
Communication distance: 9600 baud rate, the longest distance can reach 1,000m when using 120Ω shielding twisted pair.

Once maximum 120 data of byte register can be read.

Up to 32 controllers can be connected for network communication.

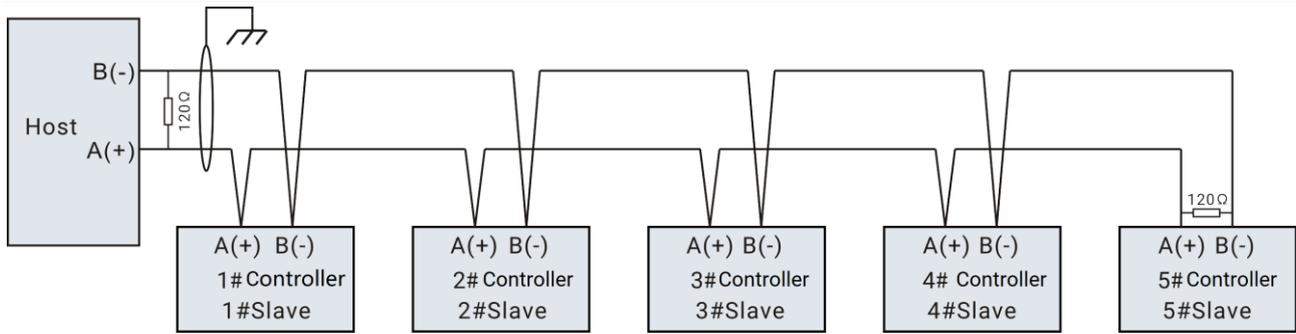
When RS485 is connected, 120Ω twisted pair with shielding layer shall be used, and the shielding layer shall be grounded at one end.

## 2. WIRING DIAGRAM



**Fig.1 Single Unit Communication Wiring Diagram**

**NOTE 1:** A 120Ω impedance matching resistor may be short connected to Terminal 26/27 according to the on-site situation, please refer to the following descriptions.



**Fig.2 Multi Units Communication Wiring Diagram**

**NOTE1:** Please set each controller’s communication module address before networking. Same module address is inhibited in the same network.

**NOTE 2:** The shielding layer of communication line is single-end grounded on the host side.

**3. CONTROLLER INTERNAL REGISTER ADDRESS AND DATA**

In the following table, S1 refers to 1# power, S2 refers to 2# power, “/” means this item is reserved.

**3.1 ALARM, STATUS COIL DATA FIELD CORRESPONDING TO FUNCTION CODE 03H**

**Table 2 Alarm, Status Coil Data Field**

| Modbus Address | PLC Address | Name               | Description   |
|----------------|-------------|--------------------|---|
| 500.0          | 40501.0     | Common Alarm       | 0 means no common alarm;<br>1 means there is common alarm.<br>(500.0 is the Boolean value of bit 0 of address 500)<br>The following contents in turn. |
| 500.1          | 40501.1     | Common Warn Alarm  |   |
| 500.2          | 40501.2     | Common Fault Alarm |   |
| 500.3          | 40501.3     | LONO Output        |   |
| 500.4          | 40501.4     | Reserved           |   |
| 500.5          | 40501.5     | Reserved           |   |
| 500.6          | 40501.6     | Reserved           |   |
| 500.7          | 40501.7     | Reserved           |   |
| 500.8          | 40501.8     | Auto Mode          | 0: Manual Mode<br>1: Auto Mode  |
| 500.9          | 40501.9     | Reserved           |   |
| 500.10         | 40501.10    | S1 Master          | S1 refers to 1# power,<br>1 represents 1# power is the common power.<br>0 represents 1# power is the backup power.                                    |
| 500.11         | 40501.11    | S2 Master          | S2 refers to 2# power,<br>1 represents 2# power is the common power.  |

| Modbus Address | PLC Address | Name                      | Description   |
|----------------|-------------|---------------------------|---|
|                |             |                           | 0 represents 2# power is the backup power.  |
| 500.12         | 40501.12    | OFF Mode                  | The controller will exit the control.   |
| 500.13         | 40501.13    | Reserved                  |   |
| 500.14         | 40501.14    | Reserved                  |   |
| 500.15         | 40501.15    | Genset Start Output       | 0 represents genset start signal not output;<br>1 represents genset start signal outputs. |
| 501.0          | 40502.0     | S1 Voltage Normal         |   |
| 501.1          | 40502.1     | S1 Voltage Abnormal       |   |
| 501.2          | 40502.2     | S1 Volt Instant. Abnormal |   |
| 501.3          | 40502.3     | S1 Volt Instant. Normal   |   |
| 501.4          | 40502.4     | /                         |   |
| 501.5          | 40502.5     | /                         |   |
| 501.6          | 40502.6     | /                         |   |
| 501.7          | 40502.7     | /                         |   |
| 501.8          | 40502.8     | S1 Blackout               |   |
| 501.9          | 40502.9     | S1 Over Voltage           |   |
| 501.10         | 40502.10    | S1 Under Voltage          |   |
| 501.11         | 40502.11    | S1 Over Frequency         |   |
| 501.12         | 40502.12    | S1 Under Frequency        |   |
| 501.13         | 40502.13    | S1 Loss of Phase          |   |
| 501.14         | 40502.14    | S1 Reverse Phase Seq.     |   |
| 501.15         | 40502.15    | /                         |   |
| 502.0          | 40503.0     | S2 Voltage Normal         |   |
| 502.1          | 40503.1     | S2 Voltage Abnormal       |   |
| 502.2          | 40503.2     | S2 Volt Instant. Abnormal |   |
| 502.3          | 40503.3     | S2 Volt Instant. Normal   |   |
| 502.4          | 40503.4     | /                         |   |
| 502.5          | 40503.5     | /                         |   |
| 502.6          | 40503.6     | /                         |   |
| 502.7          | 40503.7     | /                         |   |
| 502.8          | 40503.8     | S2 Blackout               |   |
| 502.9          | 40503.9     | S2 Over Voltage           |   |
| 502.10         | 40503.10    | S2 Under Voltage          |   |
| 502.11         | 40503.11    | S2 Over Frequency         |   |
| 502.12         | 40503.12    | S2 Under Frequency        |   |
| 502.13         | 40503.13    | S2 Loss of Phase          |   |
| 502.14         | 40503.14    | S2 Reverse Phase Seq.     |   |
| 502.15         | 40503.15    | /                         |   |
| 503.0          | 40504.0     | ATS Transfer Failure      |   |
| 503.1          | 40504.1     | S1 Close Failure          |   |
| 503.2          | 40504.2     | S1 Open Failure           |   |

| Modbus Address | PLC Address | Name                     | Description  |
|----------------|-------------|--------------------------|--|
| 503.3          | 40504.3     | /                        |  |
| 503.4          | 40504.4     | S2 Close Failure         |  |
| 503.5          | 40504.5     | S2 Open Failure          |  |
| 503.6          | 40504.6     | /                        |  |
| 503.7          | 40504.7     | /                        |  |
| 503.8          | 40504.8     | /                        |  |
| 503.9          | 40504.9     | /                        |  |
| 503.10         | 40504.10    | Forced Open Fault Alarm  |  |
| 503.11         | 40504.11    | /                        |  |
| 503.12         | 40504.12    | /                        |  |
| 503.13         | 40504.13    | ATS Trip Fault Alarm     |  |
| 503.14         | 40504.14    | /                        |  |
| 503.15         | 40504.15    | Simultaneous Close Fault |  |
| 504.0          | 40505.0     | /                        |  |
| 504.1          | 40505.1     | /                        |  |
| 504.2          | 40505.2     | Forced Open Warning      |  |
| 504.3          | 40505.3     | /                        |  |
| 504.4          | 40505.4     | /                        |  |
| 504.5          | 40505.5     | /                        |  |
| 504.6          | 40505.6     | /                        |  |
| 504.7          | 40505.7     | /                        |  |
| 504.8          | 40505.8     | /                        |  |
| 504.9          | 40505.9     | /                        |  |
| 504.10         | 40505.10    | /                        |  |
| 504.11         | 40505.11    | /                        |  |
| 504.12         | 40505.12    | /                        |  |
| 504.13         | 40505.13    | /                        |  |
| 504.14         | 40505.14    | /                        |  |
| 504.15         | 40505.15    | /                        |  |
| 505.0          | 40506.0     | Aux. Input 1 Status      | 0 represents input is inactive,<br>1 represents input is active. |
| 505.1          | 40506.1     | /                        |  |
| 505.2          | 40506.2     | /                        |  |
| 505.3          | 40506.3     | /                        |  |
| 505.4          | 40506.4     | /                        |  |
| 505.5          | 40506.5     | /                        |  |
| 505.6          | 40506.6     | /                        |  |
| 505.7          | 40506.7     | /                        |  |
| 505.8          | 40506.8     | /                        |  |
| 505.9          | 40506.9     | /                        |  |
| 505.10         | 40506.10    | /                        |  |
| 505.11         | 40506.11    | /                        |  |
| 505.12         | 40506.12    | /                        |  |

| Modbus Address | PLC Address | Name                    | Description  |
|----------------|-------------|-------------------------|--|
| 505.13         | 40506.13    | /                       |  |
| 505.14         | 40506.14    | /                       |  |
| 505.15         | 40506.15    | /                       |  |
| 506.0          | 40507.0     | Aux. Output 1 Status    | 1 represents output is active,<br>0 represents output is inactive. |
| 506.1          | 40507.1     | /                       |  |
| 506.2          | 40507.2     | /                       |  |
| 506.3          | 40507.3     | /                       |  |
| 506.4          | 40507.4     | /                       |  |
| 506.5          | 40507.5     | /                       |  |
| 506.6          | 40507.6     | /                       |  |
| 506.7          | 40507.7     | /                       |  |
| 506.8          | 40507.8     | /                       |  |
| 506.9          | 40507.9     | /                       |  |
| 506.10         | 40507.10    | /                       |  |
| 506.11         | 40507.11    | /                       |  |
| 506.12         | 40507.12    | /                       |  |
| 506.13         | 40507.13    | /                       |  |
| 506.14         | 40507.14    | /                       |  |
| 506.15         | 40507.15    | /                       |  |
| 507.0          | 40508.0     | S1 Close Control Output |  |
| 507.1          | 40508.1     | S1 Open Control Output  |  |
| 507.2          | 40508.2     | S2 Close Control Output |  |
| 507.3          | 40508.3     | S2 Open Control Output  |  |
| 507.4          | 40508.4     | S1 ATS Closing Status   |  |
| 507.5          | 40508.5     | S2 ATS Closing Status   |  |
| 507.6          | 40508.6     | Forced Open Status      |  |
| 507.7          | 40508.7     | /                       |  |
| 507.8          | 40508.8     | /                       |  |
| 507.9          | 40508.9     | /                       |  |
| 507.10         | 40508.10    | /                       |  |
| 507.11         | 40508.11    | /                       |  |
| 507.12         | 40508.12    | Remote Start On-load    |  |
| 507.13         | 40508.13    | Remote Start Off-load   |  |
| 507.14         | 40508.14    | Mains Abnormal Start    |  |
| 507.15         | 40508.15    | /                       |  |
| 508.0          | 40509.0     | /                       |  |
| 508.1          | 40509.1     | /                       |  |
| 508.2          | 40509.2     | /                       |  |
| 508.3          | 40509.3     | /                       |  |
| 508.4          | 40509.4     | /                       |  |
| 508.5          | 40509.5     | /                       |  |
| 508.6          | 40509.6     | /                       |  |

| Modbus Address | PLC Address | Name                                | Description |
|----------------|-------------|-------------------------------------|-------------|
| 508.7          | 40509.7     | /                                   |             |
| 508.8          | 40509.8     | /                                   |             |
| 508.9          | 40509.9     | /                                   |             |
| 508.10         | 40509.10    | Start Inhibit                       |             |
| 508.11         | 40509.11    | /                                   |             |
| 508.12         | 40509.12    | S1 Close Inhibit                    |             |
| 508.13         | 40509.13    | S2 Close Inhibit                    |             |
| 508.14         | 40509.14    | /                                   |             |
| 508.15         | 40509.15    | /                                   |             |
| 509.0          | 40510.0     | /                                   |             |
| 509.1          | 40510.1     | /                                   |             |
| 509.2          | 40510.2     | /                                   |             |
| 509.3          | 40510.3     | /                                   |             |
| 509.4          | 40510.4     | /                                   |             |
| 509.5          | 40510.5     | /                                   |             |
| 509.6          | 40510.6     | Fire Linkage Output                 |             |
| 509.7          | 40510.7     | /                                   |             |
| 509.8          | 40510.8     | /                                   |             |
| 509.9          | 40510.9     | /                                   |             |
| 509.10         | 40510.10    | /                                   |             |
| 509.11         | 40510.11    | Auto Transfer/Restore Digital Input |             |
| 509.12         | 40510.12    | Remote Inhibit Digital Input        |             |
| 509.13         | 40510.13    | /                                   |             |
| 509.14         | 40510.14    | /                                   |             |
| 509.15         | 40510.15    | /                                   |             |

**Example:**

If need to read “Manual/Auto Status” and “Master Status”, firstly get their corresponding address is 500.8, 500.10 and 500.11 by checking the table, it is known that you need to read 1 addresses’ data.

Assume the slave (controller) address is 01, the master (can be computer) request command is as following:

**Table 3 Master (Computer) Request Command**

| Slave Address | Function Code | Starting Address (500) |           | Data Qty. (2) |           | CRC 16 Calibration |           |
|---------------|---------------|------------------------|-----------|---------------|-----------|--------------------|-----------|
|               |               | MSB                    | LSB       | MSB           | LSB       | LSB                | MSB       |
| <b>01</b>     | <b>03</b>     | <b>01</b>              | <b>F4</b> | <b>00</b>     | <b>01</b> | <b>C4</b>          | <b>04</b> |

Slave response command is as following:

**Table 4 Slave (Controller) Response Command**

| Slave Address | Function Code | Data Qty. (Bytes) | Data                    |                         | CRC 16 Calibration |     |
|---------------|---------------|-------------------|-------------------------|-------------------------|--------------------|-----|
|               |               |                   | Data MSB of Address 500 | Data LSB of Address 500 | LSB                | MSB |
| 01            | 03            | 02                | 05                      | 00                      | BB                 | 14  |

**Table 5 Data Analysis**

| Address | Received Data (Hex) | Convert to Binary  | Data Signification   |
|---------|---------------------|--|--|
| 500     | 0500H               | 0000 0101 0000 0000<br>(correspond to 500.15, 500.14.....500.1, 500.0) | Data of bit 10 is 1 indicates that S1 is master, data of bit 8 is 1 indicates the Auto Mode. |

**3.2 VALUE DATA FIELD CORRESPONDING TO FUNCTION CODE 03H**

**Table 6 Value Data Field**

| Modbus Address | PLC Address | Name                                | Range (Decimal) | Ratio | Unit | Description     | Remark                |
|----------------|-------------|-------------------------------------|-----------------|-------|------|-----------------|-----------------------|
| 1000           | 41001       | UAB1<br>(1# AB Line Voltage)        | 0~65000         | 1     | V    | 16-bit Unsigned |                       |
| 1001           | 41002       | UBC1<br>(1# BC Line Voltage)        | 0~65000         | 1     | V    | 16-bit Unsigned |                       |
| 1002           | 41003       | UCA1<br>(1# CA Line Voltage)        | 0~65000         | 1     | V    | 16-bit Unsigned |                       |
| 1003           | 41004       | UA1<br>(1# A Phase Voltage)         | 0~65000         | 1     | V    | 16-bit Unsigned |                       |
| 1004           | 41005       | UB1<br>(1# B Phase Voltage)         | 0~65000         | 1     | V    | 16-bit Unsigned |                       |
| 1005           | 41006       | UC1<br>(1# C Phase Voltage)         | 0~65000         | 1     | V    | 16-bit Unsigned |                       |
| 1006           | 41007       | UA1 Phase<br>(1# A Phase)           | 0~360.0         | 0.1   | °    | 16-bit Unsigned | <a href="#">NOTE3</a> |
| 1007           | 41008       | UB1 Phase<br>(1# B Phase)           | 0~360.0         | 0.1   | °    | 16-bit Unsigned |                       |
| 1008           | 41009       | UC1 Phase<br>(1# C Phase)           | 0~360.0         | 0.1   | °    | 16-bit Unsigned |                       |
| 1009           | 41010       | Frequency 1<br>(1# Power Frequency) | 0~100.00        | 0.01  | Hz   | 16-bit Unsigned |                       |

| Modbus Address | PLC Address | Name                                | Range (Decimal) | Ratio | Unit | Description     | Remark |
|----------------|-------------|-------------------------------------|-----------------|-------|------|-----------------|--------|
| 1010           | 41011       | /                                   |                 |       |      |                 |        |
| 1011           | 41012       | /                                   |                 |       |      |                 |        |
| 1012           | 41013       | /                                   |                 |       |      |                 |        |
| 1013           | 41014       | /                                   |                 |       |      |                 |        |
| 1014           | 41015       | /                                   |                 |       |      |                 |        |
| 1015           | 41016       | /                                   |                 |       |      |                 |        |
| 1016           | 41017       | /                                   |                 |       |      |                 |        |
| 1017           | 41018       | /                                   |                 |       |      |                 |        |
| 1018           | 41019       | /                                   |                 |       |      |                 |        |
| 1019           | 41020       | /                                   |                 |       |      |                 |        |
| 1020           | 41021       | UAB2<br>(2# AB Line Voltage)        | 0~65000         | 1     | V    | 16-bit Unsigned |        |
| 1021           | 41022       | UBC2<br>(2# BC Line Voltage)        | 0~65000         | 1     | V    | 16-bit Unsigned |        |
| 1022           | 41023       | UCA2<br>(2# CA Line Voltage)        | 0~65000         | 1     | V    | 16-bit Unsigned |        |
| 1023           | 41024       | UA2<br>(2# A Phase Voltage)         | 0~65000         | 1     | V    | 16-bit Unsigned |        |
| 1024           | 41025       | UB2<br>(2# B Phase Voltage)         | 0~65000         | 1     | V    | 16-bit Unsigned |        |
| 1025           | 41026       | UC2<br>(2# C Phase Voltage)         | 0~65000         | 1     | V    | 16-bit Unsigned |        |
| 1026           | 41027       | UA2 Phase<br>(2# A Phase)           | 0~360.0         | 0.1   | °    | 16-bit Unsigned |        |
| 1027           | 41028       | UB2 Phase<br>(2# B Phase)           | 0~360.0         | 0.1   | °    | 16-bit Unsigned |        |
| 1028           | 41029       | UC2 Phase<br>(2# C Phase)           | 0~360.0         | 0.1   | °    | 16-bit Unsigned |        |
| 1029           | 41030       | Frequency 2<br>(2# Power Frequency) | 0~100.00        | 0.01  | Hz   | 16-bit Unsigned |        |
| 1030           | 41031       |                                     |                 |       |      |                 |        |
| 1031           | 41032       |                                     |                 |       |      |                 |        |
| 1032           | 41033       |                                     |                 |       |      |                 |        |
| 1033           | 41034       | /                                   |                 |       |      |                 |        |
| 1034           | 41035       | /                                   |                 |       |      |                 |        |
| 1035           | 41036       | /                                   |                 |       |      |                 |        |

| Modbus Address | PLC Address | Name                         | Range (Decimal) | Ratio | Unit | Description     | Remark                               |
|----------------|-------------|------------------------------|-----------------|-------|------|-----------------|--------------------------------------|
| 1036           | 41037       | /                            |                 |       |      |                 |                                      |
| 1037           | 41038       | /                            |                 |       |      |                 |                                      |
| 1038           | 41039       | /                            |                 |       |      |                 |                                      |
| 1039           | 41040       | /                            |                 |       |      |                 |                                      |
| 1040           | 41041       |                              |                 |       |      |                 |                                      |
| 1041           | 41042       |                              |                 |       |      |                 |                                      |
| 1042           | 41043       | S1 Voltage Status            | 0~65535         | No.   |      | 16-bit Unsigned | See S1 power status description.     |
| 1043           | 41044       | S1 Voltage Status Delay      | 0~65535         | 1     | s    | 16-bit Unsigned |                                      |
| 1044           | 41045       | S2 Voltage Status            | 0~65535         | No.   |      | 16-bit Unsigned | See S2 power status description.     |
| 1045           | 41046       | S2 Voltage Status Delay      | 0~65535         | 1     | s    | 16-bit Unsigned |                                      |
| 1046           | 41047       | Genset Status                | 0~65535         | No.   |      | 16-bit Unsigned | See genset power status description. |
| 1047           | 41048       | Genset Status Delay          | 0~65535         | 1     | s    | 16-bit Unsigned |                                      |
| 1048           | 41049       | ATS Status                   | 0~65535         | No.   |      | 16-bit Unsigned | See ATS status description.          |
| 1049           | 41050       | ATS Status Delay             | 0~65535         | 1     | s    | 16-bit Unsigned |                                      |
| 1050           | 41051       | Reserved                     |                 |       |      |                 |                                      |
| 1051           | 41052       | Backup Active Status         |                 |       |      |                 |                                      |
| 1052           | 41053       | Reserved                     |                 |       |      |                 |                                      |
| 1053           | 41054       | Auto Trans. Auto Restore Set |                 |       |      |                 |                                      |

**NOTE1:** Actual value=Received Data\*Ratio. Take frequency as the example, received data is 5000 (1F4H), ratio is 0.1Hz, so the actual frequency value is 50.0Hz (5000\*0.1Hz);

**NOTE2:** For 4-byte data, the actual value=Received Data MSB\*65536 + Received Data LSB;

**NOTE3:** When the received data is 32766, it means no normal data, “###” can be displayed;

**NOTE4:** Definition of signed number. Take received data 8000H as the example, transfer it to binary 1000 0000 0000 0000b, the MSB is 1, which is a negative number. One’s complement is obtained by subtracting 1 from it, which is inverted to obtain the absolute value of the negative number. Then transfer it to -32768 in decimal.

**Example:**

Read “UAB1, UBC1”, firstly get their corresponding address is 1000 and 1001 by checking the table, then it is known that you need to read 1 byte’ data.

Assume the slave address is 01, the master request command is as following:

**Table 7 Master Request Command**

| Slave Address | Function Code | Starting Address (1000) |     | Data Qty. (2) |     | CRC 16 Calibration |     |
|---------------|---------------|-------------------------|-----|---------------|-----|--------------------|-----|
|               |               | MSB                     | LSB | MSB           | LSB | LSB                | MSB |
| 01            | 03            | 03                      | EB  | 00            | 02  | 44                 | 7B  |

Slave response command is as following:

**Table 8 Slave Response Command**

| Slave Address | Function Code | Data Qty. (Bytes) | Data                     |                          |                          |                          | CRC 16 Calibration |     |
|---------------|---------------|-------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------|-----|
|               |               |                   | Data MSB of Address 1000 | Data LSB of Address 1000 | Data MSB of Address 1001 | Data LSB of Address 1001 | LSB                | MSB |
| 01            | 03            | 04                | 01                       | 7C                       | 01                       | 7C                       | 3A                 | 66  |

Fill the received data into the corresponding address, as shown in the table below:

**Table 9 Data Analysis**

| Address | Received Data (Hex) |
|---------|---------------------|
| 1000    | 017CH               |
| 1001    | 017CH               |

**3.3 REMOTE COIL FIELD CORRESPONDING TO FUNCTION CODE 05H**

**Table 10 Remote Coil Field**

| Modbus Address | PLC Address | Item                | Description  |
|----------------|-------------|---------------------|--|
| 15000          | 15001       | Remote S1 Close     | Only send FF00H active   |
| 15001          | 15002       | Remote S1 Open      | Only send FF00H active   |
| 15002          | 15003       | Remote S2 Close     | Only send FF00H active   |
| 15003          | 15004       | Remote S2 Open      | Only send FF00H active   |
| 15004          | 15005       | Auto/Manual         | Manual Mode: Only send 0000H active<br>Auto Mode: Only send FF00H active |
| 15005          | 15006       | S1 Master Set       | Only send FF00H active   |
| 15006          | 15007       | S2 Master Set       | Only send FF00H active   |
| 15007          | 15008       | Alarm Reset         | Only send FF00H active   |
| 15008          | 15009       | Remote Genset Start | Only send FF00H active   |
| 15009          | 15010       | Remote Genset Stop  | Only send FF00H active   |
| 15010          | 15011       | OFF                 | Only send FF00H active   |
| 15011          | 15012       | /                   | Only send FF00H active   |
| 15012          | 15013       | Remote Control      | Only send FF00H active   |

**NOTE:** Remote command in the above table can be sent once only.

**Example:**

Remotely control controller to work in auto mode, firstly get its remote address is 15004 by checking the table.

Assume that slave address is 01, the master request command is as following:

**Table 11 Master Request Command**

| Slave Address | Function Code | Remote Address (15004) |     | Data |     | CRC 16 Calibration |     |
|---------------|---------------|------------------------|-----|------|-----|--------------------|-----|
|               |               | MSB                    | LSB | MSB  | LSB | LSB                | MSB |
| 01            | 05            | 3A                     | 9C  | FF   | 00  | 40                 | CC  |

Slave response command is as following:

**Table 12 Slave Response Command**

| Slave Address | Function Code | Remote Address (15004) |     | Data |     | CRC 16 Calibration |     |
|---------------|---------------|------------------------|-----|------|-----|--------------------|-----|
|               |               | MSB                    | LSB | MSB  | LSB | LSB                | MSB |
| 01            | 05            | 3A                     | 9C  | FF   | 00  | 40                 | CC  |

Then whether the remote command is executed successfully can be confirmed by reading the auto mode status of address 500.8 via function code 03H.

**3.4 S1 POWER STATUS DESCRIPTION**

**Table 13 S1 Power Status Description**

| Value (No.) | Status                    | Delay           |
|-------------|---------------------------|-----------------|
| 0           | S1 Available              | Delay (Unit: s) |
| 1           | S1 Unavailable            | Delay (Unit: s) |
| 2           | S1 Voltage Normal         | No Delay        |
| 3           | S1 Blackout               | No Delay        |
| 4           | S1 Over Voltage           | No Delay        |
| 5           | S1 Under Voltage          | No Delay        |
| 6           | S1 Over Frequency         | No Delay        |
| 7           | S1 Under Frequency        | No Delay        |
| 8           | S1 Loss of Phase          | No Delay        |
| 9           | S1 Reverse Phase Sequence | No Delay        |

**Example:**

If the content of address 1042 is 1, 1043 is 5, it indicates that currently 1# power is in voltage abnormal delay, countdown 5s.

If the content of address 1042 is 4, it indicates that currently 1# power has over voltage.

**3.5 S2 POWER STATUS DESCRIPTION**

**Table 14 S2 Power Status Description**

| Value (No.) | Status            | Delay           |
|-------------|-------------------|-----------------|
| 0           | S2 Available      | Delay (Unit: s) |
| 1           | S2 Unavailable    | Delay (Unit: s) |
| 2           | S2 Voltage Normal | No Delay        |
| 3           | S2 Blackout       | No Delay        |
| 4           | S2 Over Voltage   | No Delay        |
| 5           | S2 Under Voltage  | No Delay        |

| Value (No.) | Status                    | Delay    |
|-------------|---------------------------|----------|
| 6           | S2 Over Frequency         | No Delay |
| 7           | S2 Under Frequency        | No Delay |
| 8           | S2 Loss of Phase          | No Delay |
| 9           | S2 Reverse Phase Sequence | No Delay |

### 3.6 GENSET STATUS DESCRIPTION

**Table 15 Genset Status Description**

| Value (No.) | Status         | Delay           |
|-------------|----------------|-----------------|
| 0           | Start Delay    | Delay (Unit: s) |
| 1           | Stop Delay     | Delay (Unit: s) |
| 2           | Genset Start   | No Delay        |
| 3           | Genset Standby | No Delay        |

**Example:**

If the content of address 1046 is 1, 1047 is 50, it indicates that genset is preparing to stop, countdown 50s.

If the content of address 1046 is 2, it indicates that genset has been started.

### 3.7 ATS STATUS DESCRIPTION

**Table 16 ATS Status Description**

| Value (No.) | Status            | Delay           |
|-------------|-------------------|-----------------|
| 0           | Ready to Transfer | No Delay        |
| 1           | S1 Closing        | Delay (Unit: s) |
| 2           | S1 Opening        | Delay (Unit: s) |
| 3           | S2 Closing        | Delay (Unit: s) |
| 4           | S2 Opening        | Delay (Unit: s) |
| 5           | Transfer Rest     | Delay (Unit: s) |
| 6           | S1 Re-closing     | Delay (Unit: s) |
| 7           | S1 Re-opening     | Delay (Unit: s) |
| 8           | S2 Re-closing     | Delay (Unit: s) |
| 9           | S2 Re-opening     | Delay (Unit: s) |
| 10          | S1 On-load        | No Delay        |
| 11          | S2 On-load        | No Delay        |
| 12          | Off-load          | No Delay        |

## 4. FAQ

### 4.1 COMMUNICATION LINE SHIELDING LAYER GROUNDED

In order to prevent coupled interference signal on communication line, its single end needs to be grounded.

### 4.2 TERMINAL RESISTOR

At both ends of the linear network (on the two communication ports furthest apart), it is necessary to connect 120Ω terminal resistor in parallel on a pair of communication lines. According to the transmission line theory, the terminal resistor can absorb reflected waves on the network, effectively enhancing the signal strength. The value of two terminal resistors in parallel should be approximately equal to the characteristic impedance of the transmission line at the communication frequency.

A regular RS485 network usually uses terminal resistor. It can also be not used in the case of network connection line is very short, temporary or laboratory test.

### 4.3 RS485 TO USB COMMUNICATION ADAPTOR

PC can communicate with SG72A module produced by our company.

### 4.4 EXTENDED COMMUNICATION DISTANCE

Long distance (up to 10km) communication can be realized by a pair of SGCAN300 CANBUS relay modules.



**Fig.3 SGCAN300 Application Diagram**

### 4.5 COMMON SOLUTIONS OF COMMUNICATION FAILURE

- 1) Check whether the positive and negative of RS485 is correctly connected; check whether the RS485 converter (if configured) is normal;
- 2) Check whether the terminal resistor is correctly connected;
- 3) Check whether the communication parameter setting in parameter setting is correct; the baud rate, data bit and parity bit and stop bit should be the same as the requirement of the controller;
- 4) Whether the selected COM port corresponds to the USB port where RS485 converter is connected;
- 5) Whether the communication address is correct, factory default is 01;
- 6) When using 03 function code, up to 120 addresses can be read of data length for each time, and the last address can't exceed the max. Modbus communication address. The write function of 06 function code map data area can only write one address at a time;
- 7) If there is an offset address in Modbus communication address, you need to add the original base address to the offset address to obtain the correct Modbus communication address;
- 8) 05 function code using Modbus address for communication: despite 1 for active, 0 for inactive, only sending FF00H can make corresponding bit as 1, sending 0000H can make

- corresponding bit as 0; while using PLC address for communication: sending 1 to position 1, sending 0 to position 0;
- 9) Whether CRC-16 LSB first and MSB last are correct;
  - 10) It is better not read controller data too fast for multiple times, the interval for 500ms is recommended;
  - 11) Please configure the communication module address of the controller before networking. Don not have the same the module address in the same network;
  - 12) Since the Modbus serial protocol does not support the multiple masters, multiple software can't communicate with the controller at the same time;
  - 13) Disconnect the RS485 wiring and measure the voltage difference between terminal A and B of RS485. If the voltage difference is between  $\pm 200\text{mV}$ , the communication port is abnormal.
  - 14) If the long communication distance results in the signal attenuation, it is better to replace the cable with high quality, or add a repeater in the middle of the communication cable;
  - 15) The third-party software of serial port communication, such as modscan32 and modbus poll are recommended, which can verify the communication is normal or not.

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