



**SmartGen**  
ideas for power

**MGC300**  
**GENSET CONTROLLER**  
**COMMUNICATION PROTOCOL**

SmartGen

**SMARTGEN (ZHENGZHOU) TECHNOLOGY CO., LTD.**



Chinese trademark

**SmartGen** English trademark

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**Table 1 - Version History**

Date	Version	Note
2019-10-23	1.0	Original release.

This is applicable for MGC300 Genset Controller.

Symbol illustration for this protocol:

**Table 2 - Symbol Illustration**

Sign	Remark
 <b>NOTE</b>	Highlights an essential element of a procedure to ensure correctness;
 <b>CAUTION!</b>	Indicates a procedure or practice, which, if not strictly observed, could result in damage or destruction of equipment;
 <b>WARNING</b>	Indicates a procedure or practice, which could result in injury to personnel or loss of life if not followed correctly.

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## 1. INTRODUCTION

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

MODBUS communication protocol allows the module to transfer information and data effectively with PLC, RTU, SCADA system of international brands (such as, Schneider, Siemens, and Modicon etc.), and DCS or third-party monitoring system which is compatible with MODBUS. The monitoring system can be set up if a central PC (or IPC)-based communication master software is added (such as Kingview, Intouch, FIX, Synall etc.).

## 2. MODBUS BASIC RULES

- All communication loops should follow the master-slave mode. In this way, data can be transferred between a master (e.g. PC) and 32 slaves.
- No communication can start from slaves.
- In communication loop, all communication should be transmitted in “information frame”.
- If master or slave receives information frame with unknown command, no response will be given.

## 3. DATA FRAME FORMAT

Communication is asynchronously transferred by the unit of byte (data frame). Each data frame is a serial data stream of 10 bits (stop bit: 1) or 11 bits (stop bit: 2) between master and slave.

**Table 3 - Data Frame Format**

Item	Description
Start bit	1-bit
Data bit	8-bit
Parity bit	No parity
Stop bit	1-bit, 2-bit can be set.
Baud rate	9600bps

## 4. COMMUNICATION PROTOCOL

### 4.1 ILLUSTRATION

When communication command is sent to the instrument, device who accords with the address code receives the communication command, and removes the address code to read information. If nothing goes wrong, it shall conduct the task, and then send implementation result to the sender. The returned information includes address code, function code of implemented action, data after implemented action, and CRC. If an error occurs, then nothing shall be sent.

## 4.2 INFORMATION FRAME FORMAT

**Table 4 – Information Frame Format**

Initiating structure	Address code	Function code	Data field	CRC	End structure
Delay (equivalent to 4 bytes)	1 byte 8-bit	1 byte 8-bit	N bytes N*8-bit	2 bytes 16-bit	Delay (equivalent to 4 bytes)

### 4.3 ADDRESS CODE

Address code is the first data frame (8-bit) in each transmitted information frame. This device address range is 1–255, which means that slave device whose address code is defined by users will receive the information sent by the master. Each slave has a unique address code, and each response begins with its address code. The address code issued by the master means the slave address to be sent to, while address code issued by slave means the responded slave address.

### 4.4 FUNCTION CODE

#### 4.4.1 ILLUSTRATION

Function code is the second data of each communication transmission. ModBus communication protocol defines function code as 1-255 (01H-0FFH). MGC300 controller uses a part of it. By master request master can tell slave to conduct certain action. By slave response slave can show that it has responded to the master and conducted the action as the function code issued by the slave is the same as the one issued by the master. If the function code MSB is 1 (function code > 127), it means slave does not respond, or response has an error.

The following table shows the specific signification and operation of function code.

**Table 5 - ModBus Partial Function Codes**

Function code	Definition	Operation
03H	Read Holding Registers	Reads single or multiple register data;
05H	Force Single Coil	Forces a single coil;
06H	Write Single Register	Write a 16-bit binary number to register;

#### 4.4.2 03H READ REGISTERS

With communication command of function code 03H, master can read the numerical registers (all kinds of collected analogue data and pre-set parameter values are stored in the register) inside the instrument. Input register value of 03H mapping data field is 16-bit (2 bytes). So register values read from the instrument are all 2 bytes. For each time maximum readable register values are 125.

Command format of slave response is address code, function code, data field, and CRC code. Data in data field are dual bytes in a group of 2 bytes and high byte is in the front.

#### 4.4.3 05H FORCE SINGLE COIL

With this command master can store single coil data to bit registers (e.g. ATS transfer control). Slave also can respond information to the master with this command.

#### 4.4.4 06H WRITE SINGLE REGISTER

With this command master can store single data to bit registers in the instrument. Register in ModBus communication protocol refers to 16-bit (2 bytes) and high byte is in the front. In this way all points in the device are 2 bytes. Command format is slave address, function code, data field and CRC code.

### 4.5 DATA FIELD

#### 4.5.1 ILLUSTRATION

Data field varies with different function codes.

#### 4.5.2 FUNCTION 03H DATA FIELD FORMAT

**Table 6 - Master Request**

Data Sequence	Data Signification	Byte Count
1	Starting address	2
2	Read register numbers	2

**Table 7 - Slave Response**

Data Sequence	Data Signification	Byte Count
1	Loopback byte count	1
2	N register data	N

#### 4.5.3 FUNCTION 05H DATA FIELD FORMAT

**Table 8 - Master Request**

Data Sequence	Data Signification	Byte Count
1	Coil address	2
2	Force single coil value	2

**Table 9 - Slave Response**

Data Sequence	Data Signification	Byte Count
1	Coil address	2
2	Single coil value	2

#### 4.5.4 FUNCTION 06H DATA FIELD FORMAT

**Table 10 - Master Request**

Data Sequence	Data Signification	Byte Count
1	Register address	2
2	Register value (2 bytes)	2

**Table 11 - Slave Response**

Data Sequence	Data Signification	Byte Count
1	Register address	2
2	Register value (2 bytes)	2

## 4.6 ERROR CHECK CODE (CRC)

Master or slave can detect whether the received information is wrong or not with CRC. Sometimes due to electric noise or other interference, information will have small change in the transmission process. CRC ensures master or slave does not respond to the wrong information in the transmission process. In this way system safety and efficiency are guaranteed. CRC applies CRC-16 calibration method.

For 2 bytes CRC, low byte is in the front and high byte is in the back.

**NOTE:** All information frame format are same: address code, function code, data area and CRC code.

CRC includes 2 bytes, which is 16-bit binary number. CRC is counted by the sender and placed at the end of the transmitted information. Responded device will count the received information is the same as the information again. If they are different, then it means there is an error.

CRC counting method: first place 16-bit register as 1. Then gradually tackle with 8-bit data information. Only 8-bit of data is used in the process of CRC counting. Start bit and stop bit are not included.

In the process of CRC counting, 8-bit data is Exclusive OR with the register data. The obtained result moves 1 bit to the low byte direction and fill MSB with 0. Check LSB again and if LSB is 1, then make register contents Exclusive OR with the preset values. If LSB is 0, then do not do Exclusive OR counting.

This process is repeated for many times. After the eighth bit move, the next 8-bit shall Exclusive OR with the current register contents. This also repeated for 8 times as the last one. Until all data information is handled, the last register contents are CRC value.

### CRC-16 CALCULATION PROCEDURE:

- 1) Place a 16-bit register as FFFF hex;
- 2) Make the first 8-bit data Exclusive OR with the low 8-bit of the CRC register, and put the result in the CRC register;
- 3) Shift the CRC register one bit to the right, and fill MSB with 0. Examine the moved-out bit.
- 4) If LSB was 0: repeat Step 3 (another shift).  
If LSB was 1: Exclusive OR the CRC register with A001 hex;
- 5) Repeat Step 3 and 4 until 8 shifts have been performed. When this is done, a complete 8-bit data are processed.
- 6) Repeat Step 2 to 5 for the next 8-bit data of the message.
- 7) The final CRC register value is the CRC code. Least Significant Byte is transmitted first and Most Significant Byte is at the last.

**NOTE:** The calculation of CRC code starts from <slave address> for all bytes, excluding <CRC code>.

## 4.7 EXAMPLES OF INFORMATION FRAME FORMAT

### 4.7.1 FUNCTION CODE 03H

Slave address is 00 and start address is 0026H of 3 data (each data is 2 bytes).

**Table 12 - Data Address Example**

Address	Data(Hex)
0026H	0014
0027H	0014
0028H	0005

**Table 13 - Function Code 03H Master Request Example**

Request	Bytes	Example (Hex)
Slave address	1	01 Send to slave 01
Function code	1	03 Read holding registers
Starting address	2	00 Starting address is 0026 26
Count number	2	00 Read 3 data (total 6 bytes) 03
CRC code	2	E4 CRC code which calculated by PC 00

**Table 14 - Function Code 03H Slave Response Example**

Response	Bytes	Example (Hex)
Slave address	1	01 Respond slave address 01
Function code	1	03 Read register
Read count	1	06 3 data (total 6 bytes)
Data 1	2	00 The content of address 0026H 14
Data 2	2	00 The content of address 0027H 14
Data 3	2	00 The content of address 0028H 05
CRC code	2	91 CRC code which calculated by slave. 71

#### 4.7.2 FUNCTION CODE 05H

Slave address is 01 and starting address is 0000H of 1 coil. Place 0000H unit 1.

**Table 15 - Coil Data Address Example**

Address	Data(Hex)
0000	0
0001	1
0002	0

**NOTE:** FF00 hex coil value is forced to 1 and 000H is forced to 0. Other values are illegal and will not affect the coil.

**Table 16 - Function Code 05H Master Request Example**

Request	Bytes	Example (Hex)
Slave address	1	01 Send slave address 01
Function code	1	05 Force single coil
Starting address	2	00 Starting address is 0000H 00
Data	2	FF Set coil as 1 00
CRC code	2	CD CRC code which calculated by PC. FB

**Table 17 - Function Code 05H Slave Response Example**

Slave Response	Bytes	For Example (Hex)
Slave address	1	01 Respond slave address 01
Function code	1	05 Force single coil
Starting address	2	00 Starting address is 0000H 00
Data	2	FF Set coil as 1 00
CRC code	2	CD CRC code which calculated by slave. FB

#### 4.7.3 Function Code 06H

Slave address is 01 and place starting address of 00E3H of 1 point as 0002H.

**Table 18 - Function Code 06H Master Request Example**

Request	Bytes	Example (Hex)
Slave address	1	01 Send slave address 01
Function code	1	06 Write single register
Starting address	2	00 Starting address is 00E3H E3
Data	2	00 Place 1 datum (2 bytes in total) 02
CRC code	2	F9 CRC code which calculated by PC. FD

**Table 19 - Function Code 06H Slave Response Example**

Slave Response	Bytes	For Example (Hex)
Slave address	1	01 Respond slave address 01
Function code	1	06 Write single register
Starting address	2	00 Starting address is 00E3H E3
Data	2	00 Place 1 datum (2 bytes in total) 02
CRC code	2	F9 CRC code which calculated by slave. FD

#### 4.8 ERROR HANDLING

When device detects other errors except the CRC code, the slave must send information to the master. The function code MSB is 1, which means the response function code by slave should add 128 based on the function code sent by the master. The following codes show that unexpected errors have occurred.

If CRC error occurs for the information received by the slave, then the device will ignore.

**Table 20 - Error Code Format of Slave Response (CRC excluded):**

Type	Byte
Address code	1 byte
Function code	1 byte (MSB is 1)
Error code	1 byte
CRC code	2 bytes

Error code:

01 illegal function code

The function code received in the query is not an allowable action for the slave.

02 illegal data address

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

03 illegal data value

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

## 5. ATTACHMENT: ADDRESS AND DATA

### 5.1 FUNCTION CODE 01 MAPPING DATA FIELD

**Table 21 - Function Code 01 Mapping Data Field**

Address	Item	Description	Byte
0	Common Alarm	1 for active(LSB)	1bit
1	Common Warning Alarm	1 for active	1bit
2	Common Shutdown Alarm	1 for active	1bit
3	Battery Under Voltage Warning	1 for active	1bit
4	Battery Over Voltage Warning	1 for active	1bit
5	Fuel Level Low Warning	1 for active	1bit
6	Mains Onload	1 for active	1bit
7	Gen Onload	1 for active	1bit
8	Reserved	1 for active	1bit
9	Reserved	1 for active	1bit
10	Gen Over Current Shutdown	1 for active	1bit
11	Input Shutdown	1 for active	1bit
12	Gen Over Frequency Shutdown	1 for active	1bit
13	Gen Under Frequency Shutdown	1 for manual	1bit
14	Gen Over Voltage Shutdown	1 for active	1bit
15	Gen Under Voltage Shutdown	1 for active(MSB)	1bit
16	Reserved	1 for active	1bit
17	Failed to Start Alarm	1 for active	1bit
18	Reserved	1 for active	1bit
19	Oil Pressure Low Shutdown	1 for active	1bit
20	Reserved	1 for active	1bit
21	Temp. High Shutdown	1 for active	1bit
22	Reserved	1 for active	1bit
23	Fuel Level Low Shutdown	1 for active	1bit
24	Reserved	1 for active	1bit
25	Reserved	1 for active	1bit
26	Reserved	1 for active	1bit
27	Reserved	1 for active	1bit
28	Reserved	1 for active	1bit
29	Reserved	1 for active	1bit
30	Reserved	1 for active	1bit
31	Reserved	1 for active	1bit
32	Failed to Stop Warning	1 for active	1bit
33	Gen Over Current Warning	1 for active	1bit
34	Reserved	1 for active	1bit
35	Reserved	1 for active	1bit
36	Reserved	1 for active	1bit
37	Reserved	1 for active	1bit

Address	Item	Description	Byte
38	Reserved	1 for active	1bit
39	Reserved	1 for active	1bit
40	System in Manual Mode	1 for active	1bit
41	System in Auto Mode	1 for active	1bit
42	System in Stop Mode	1 for active	1bit
43	System in Test Mode	1 for active	1bit
44	Reserved	1 for active	1bit
45	Reserved	1 for active	1bit
46	Reserved	1 for active	1bit
47	Genset Running	1 for active	1bit
48	Reserved	1 for active	1bit
49	Reserved	1 for active	1bit
50	Oil Pressure Digital Input Status	1 for active	1bit
51	Aux. Input Status	1 for active	1bit
52	Remote Start Digital Input Status	1 for active	1bit
53	Reserved	1 for active	1bit
54	Reserved	1 for active	1bit
55	Reserved	1 for active	1bit
56	Start Relay Output	1 for active	1bit
57	Fuel Relay Output	1 for active	1bit
58	Reserved	1 for active	1bit
59	Aux. Output 1	1 for active	1bit
60	Aux. Output 2	1 for active	1bit
61	Reserved	1 for active	1bit
62	Reserved	1 for active	1bit
63	Reserved	1 for active	1bit
64	Mains Fault	1 for active	1bit
65	Mains OK	1 for active	1bit
66	Mains Over Voltage	1 for active	1bit
67	Mains Under Voltage	1 for active	1bit
68	No Mains	1 for active	1bit
69	Mains Loss of Phase	1 for active	1bit
70	Reserved	1 for active	1bit
71	Reserved	1 for active	1bit
72	Gen OK	1 for active	1bit
73	Gen Over Voltage	1 for active	1bit
74	Gen Under Voltage	1 for active	1bit
75	Gen Over Frequency	1 for active	1bit
76	Gen Under Frequency	1 for active	1bit
77	Gen Over Current	1 for active	1bit
78	Reserved	1 for active	1bit
79	Reserved	1 for active	1bit

## 5.2 FUNCTION CODE 03H, 06H MAPPING COIL FIELD

**Table 22 - Function Code 03H, 06H Mapping Data Field**

Address	Item	Description	Byte
Base Address is 0.			
0000	Mains UA	Unsigned	2Bytes
0001	Mains UB	Unsigned	2Bytes
0002	Mains UC	Unsigned	2Bytes
0003	Mains UAB	Unsigned	2Bytes
0004	Mains UBC	Unsigned	2Bytes
0005	Mains UCA	Unsigned	2Bytes
0006	Mains Frequency	Unsigned (*10)	2Bytes
0007	Gen UA	Unsigned	2Bytes
0008	Gen UB	Unsigned	2Bytes
0009	Gen UC	Unsigned	2Bytes
0010	Gen UAB	Unsigned	2Bytes
0011	Gen UBC	Unsigned	2Bytes
0012	Gen UCA	Unsigned	2Bytes
0013	Gen Frequency	Unsigned (*10)	2Bytes
0014	Current IA	Unsigned (*10)	2Bytes
0015	Current IB	Unsigned (*10)	2Bytes
0016	Current IC	Unsigned (*10)	2Bytes
0017	Temp. Sensor Converted Value	Unsigned	2Bytes
0018	Temp. Sensor Resistance Value	Unsigned (*10)	2Bytes
0019	Fuel Level Sensor Converted Value	Unsigned	2Bytes
0020	Fuel Level Sensor Resistance Value	Unsigned (*10)	2Bytes
0021	Reserved	Unsigned	2Bytes
0022	Reserved	Unsigned (*10)	2Bytes
0023	Speed	Unsigned (*10)	2Bytes
0024	Battery Voltage	Unsigned (*10)	2Bytes
0025	Reserved	Unsigned (*10)	2Bytes
0026	Active Power	Unsigned	2Bytes
0027	Reserved	Unsigned	2Bytes
0028	Reserved	Unsigned	2Bytes
0029	Load Output Percentage	Unsigned (*100)	2Bytes
0030	Reserved	Unsigned	2Bytes
0031	Reserved	Unsigned	2Bytes
0032	Reserved	Unsigned	2Bytes
0033	Reserved	Unsigned	2Bytes
0034	Controller Running Status; See <i>Genset Status</i> Table	Unsigned	2Bytes
0035	Delay	Unsigned	2Bytes
0036	Auto Running Status: 0 Start 1Stop 2 No Delay	Unsigned	2Bytes

Address	Item	Description	Byte
0037	Delay	Unsigned	2Bytes
0038	ATS Running Status: 0 Gen Close 2 Transfer Interval 3 Mains Close 4 No Delay	Unsigned	2Bytes
0039	Key Status	Unsigned	2Bytes
0040	Mains Status: 0 Normal 1 Abnormal 2 No Delay	Unsigned	2Bytes
0041	Delay	Unsigned	2Bytes
0042	Oil Engine Total Running Time (H) MSB	Unsigned (0-19)	2Bytes
0043	Oil Engine Total Running Time (H) LSB	Unsigned (0-9999)	2Bytes
0044	Oil Engine Total Running Time (M)	Unsigned (0-9999)	2Bytes
0045	Oil Engine Total Running Time (S)	Unsigned (0-9999)	2Bytes
0046	Start Times ( ) MSB	Unsigned (0-9999)	2Bytes
0047	Start Times ( ) LSB	Unsigned (0-9999)	2Bytes
0048	Total Power ( ) MSB	Unsigned (0-9999)	2Bytes
0049	Total Power ( ) LSB	Unsigned (0-9999)	2Bytes
0050	Software Version	Unsigned (*10)	2Bytes
0051	Hardware Version	Signed (*10)	2Bytes
0052	Release Year	Unsigned	2Bytes
0053	Release Month	Unsigned	2Bytes
0054	Release Day	Unsigned	2Bytes
0055	Model Type	Unsigned	2Bytes
0056	Reserved	Unsigned	2Bytes
0057	Reserved	Unsigned	2Bytes

**NOTE 1:** If controller detects sensor open, data is 32766 and OFF is displayed.

### 5.3 FUNCTION CODE 05H MAPPING DATA FIELD

**Table 23 - Function Code 05H Mapping Data Field**

Address	Item	Description
0000H	Remote Control: Start	Active for 1 (active for 0x00FF)
0001H	Remote Control: Stop	Active for 1 (active for 0x00FF)
0002H	Remote Control: Auto	Active for 1 (active for 0x00FF)
0003H	Remote Genset: (Test, especially for MGC320) (Manual, especially for MGC310)	Active for 1 (active for 0x00FF)
0004H	Reserved	Active for 1 (active for 0x00FF)
0005H	Reserved	Active for 1 (active for 0x00FF)
0006H	Reserved	Active for 1 (active for 0x00FF)

## 5.4 ALARM DATA

**Table 24 - Alarm Data**

Address	Item	Description	Byte
0	Common Alarm	Active for 1	
1	Common Warning Alarm	Active for 1	
2	Common Shutdown Alarm	Active for 1	
3	Battery Under Voltage Warning	Active for 1	
4	Battery Over Voltage Warning	Active for 1	
5	Fuel Level Low Warning	Active for 1	
6	Reserved	Active for 1	
7	Reserved	Active for 1	
8	Reserved	Active for 1	
9	Reserved	Active for 1	
10	Gen Over Current Shutdown	Active for 1	
11	Input Port Shutdown	Active for 1	
12	Gen Over Frequency Shutdown	Active for 1	
13	Gen Under Frequency Shutdown	Active for 1	
14	Gen Over Voltage Shutdown	Active for 1	
15	Gen Under Voltage Shutdown	Active for 1	
16	Reserved	Active for 1	
17	Failed to Start	Active for 1	
18	Reserved	Active for 1	
19	Oil Pressure Low Shutdown	Active for 1	
20	Reserved	Active for 1	
21	Temp. High Shutdown	Active for 1	
22	Reserved	Active for 1	
23	Fuel Level Low Shutdown	Active for 1	
24	Reserved	Active for 1	
25	Reserved	Active for 1	
26	Reserved	Active for 1	
27	Reserved	Active for 1	
28	Reserved	Active for 1	
29	Reserved	Active for 1	
30	Reserved	Active for 1	
31	Failed to Stop Warning	Active for 1	
32	Gen Over Current Warning (especially for MGC320)	Active for 1	
33	Reserved	Active for 1	
34	Reserved	Active for 1	
35	Reserved	Active for 1	
36	Reserved	Active for 1	
37	Reserved	Active for 1	
38	Reserved	Active for 1	
39	Reserved	Active for 1	

Address	Item	Description	Byte
40	Reserved	Active for 1	
41	Reserved	Active for 1	
42	Reserved	Active for 1	
43	Reserved	Active for 1	
44	Reserved	Active for 1	
45	Reserved	Active for 1	
46	Reserved	Active for 1	
47	Reserved	Active for 1	
48	Reserved	Active for 1	
49	Reserved	Active for 1	
50	Reserved	Active for 1	
51	Reserved	Active for 1	
52	Reserved	Active for 1	
53	Reserved	Active for 1	
54	Reserved	Active for 1	
55	Reserved	Active for 1	
56	Reserved	Active for 1	
57	Reserved	Active for 1	
58	Reserved	Active for 1	
59	Reserved	Active for 1	
60	Reserved	Active for 1	
61	Reserved	Active for 1	
62	Reserved	Active for 1	
63	Mains Fault (Indication) (MGC320)	Active for 1	
64	Mains OK (Indication) (MGC320)	Active for 1	
65	Mains Over Volt (Indication) (MGC320)	Active for 1	
66	Mains Under Volt (Indication)	Active for 1	
67	No Mains (Indication) (MGC320)	Active for 1	
68	Mains Loss of Phase (Indication) (MGC320)	Active for 1	
69	Reserved	Active for 1	
70	Reserved	Active for 1	
71	Gen OK (Indication)	Active for 1	
72	Gen Over Volt (Indication)	Active for 1	
73	Gen Under Volt (Indication)	Active for 1	
74	Gen Over Frequency (Indication)	Active for 1	
75	Gen Under Frequency (Indication)	Active for 1	
76	Gen Over Current (Indication)	Active for 1	
77	Reserved	Active for 1	
78	Reserved	Active for 1	

**5.5 GENSET STATUS**

**Table 25 - Genset Status**

No.	Contents	Description
0	Standby	No delay for this status
1	Pre-heating	
2	Fuel Output	No delay for this status
3	Crank	
4	Crank Rest Time	
5	Safety On Delay	
6	Start Idle Delay	
7	Warming Up	
8	Wait to Load	No delay for this status
9	Normal Running	No delay for this status
10	Cooling	
11	Stop Idle Delay	
12	ETS Hold Time	
13	Wait for Stop	
14	Failed to Stop	

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