HGM7100N

GENSET CONTROLLER

COMMUNICATION PROTOCOL
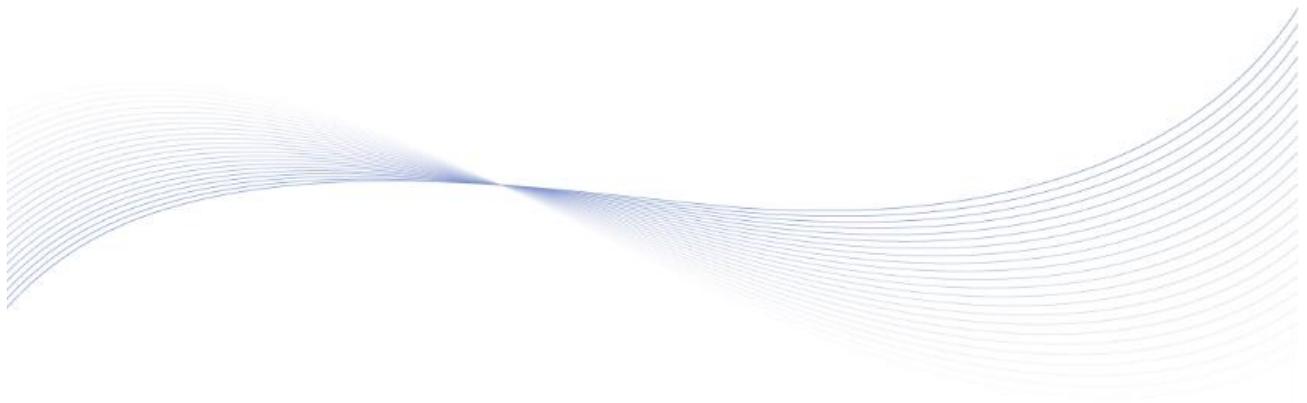
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SmartGen

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Table 1 Software Version

Date	Version	Note
2017-08-30	1.0	Original release.
2021-12-27	1.1	1. Modify mains frequency description in Function Code 03H Mapping Data Field. 2. Add gen frequency in Function Code 03H Mapping Data Field.
2024-07-31	1.2	Modify the error in Table 20.
2025-06-21	1.3	1. Update the latest document template; 2. Modify corresponding items of Address 0005 and 0006 in Function Code 05H Mapping Data Field.

CONTENTS

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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), and DCS or third-party monitoring system compatible with MODBUS. The monitoring system can be set up if only adding central communication master software (such as Kingview, Intouch, FIX, Synall) basing on PC (or IPC).

2. MODBUS BASIC RULES

1) All communication loops should follow the master-slave mode. If so, data can be transferred between a master (e.g. PC) and 32 slaves.
2) No communication can start from slaves.
3) In communication loop, all communication should be transmitted in "information frame".
4) If received information frame contains unknown command, no response will be given.

3. DATA FRAME FORMAT

Communication is asynchronously transferred, using byte (data frame) as unit. Between master and slave, every transmitted data frame is 10-bit (stop bit: 1-bit) or 11-bit (stop bit: 2-bit) serial data stream.

Table 2 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 slave, corresponding slave receives the communication command, then removes address code, and read the information. If no mistakes, it will execute commands, and sends the result back to the master. Response information includes address code, function code, data and error check code (CRC). If an error occurred in receipt of the command, it will send no information.

4.2 INFORMATION FRAME FORMAT

Table 3 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. Single device address range is 1-255; this byte shows that the slave defined by users will receive the information sent by the master. Each slave has a unique address code, and responses begin with the address code. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

4.4 FUNCTION CODE

4.4.1 ILLUSTRATION

This is the second data of each transmission. ModBus communication protocol defined function code as 1-255 (01H-0FFH). HGM7100N controller uses part of it. Master sends the request and the slave executes actions according to the function code. If the function code sent by slave is same as that sent by master, it means the response is active. But if the function code MSB is 1 (function code range>127), it means there is no response or response has error.

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

Table 4 ModBus Partial Function Codes

Function code	Definition	Operation
03H	Read Registers	Reads one or multiple register data
05H	Place Single Coil	Place single coil
06H	Write Single Register	Write a 16-bit binary data into the register

4.4.2 03H READ REGISTERS

With function code 03H command, the master can read the numerical registers inside the device (numerical registers contains various analog and parameter setting values). Input register values of function code 03H mapping data field are 16 bits (2 bytes). So, from the device reads registers values are 2 bytes. Maximum number of readable registers is 125 each time.

The slave received command format is slave address, function code, data field and the CRC code. The data of data field is in double bytes with every two bytes for a group, and high byte is in advance.

4.4.3 05H PLACE SINGLE COIL

Master uses this command to save a single coil data into bit registers in the device (such as ATS transfer control). The slave also uses this function code to feedback information to the master.

4.4.4 06H WRITE SINGLE REGISTER

Master uses this command to save a single data into bit registers in the device. Holding register in ModBus communication protocol is 16-bit (2 bytes), and high byte is in advance. Thus all points of the device are 2 bytes. Format of command is slave address, function code, data area and CRC code.

4.5 DATA FIELD

4.5.1 ILLUSTRATION

Data field varies with different function codes.

4.5.2 DATA FIELD FORMAT CORRESPONDING TO FUNCTION CODE 03H

Table 5 Master Request

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

Table 6 Slave Response

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

4.5.3 DATA FIELD FORMAT CORRESPONDING TO FUNCTION CODE 05H

Table 7 Master Request

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

Table 8 Slave Response

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

4.5.4 DATA FIELD FORMAT CORRESPONDING TO FUNCTION CODE 06H

Table 9 Master Request

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

Table 10 Slave Response

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

4.6 ERROR CHECK CODE (CRC)

The Error Check Code allows the receiving device to detect a packet that has been corrupted with transmission errors. Sometimes, the transmission information has imperceptible changes due to electronic noise and other interference and the CRC code ensure the error information does not work to increase the system's safety and efficiency. CRC adapts CRC-16 method of calibration.

When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

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

The CRC field is two bytes, containing a 16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value that received in the CRC field. If the two values are not equal, an error will result.

The CRC is started by first preloading a 16−bit register to all 1's. Then a process begins of applying successive 8−bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits do not apply to the CRC.

During generation of the CRC, each 8−bit character is exclusive OR with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive OR with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place.

This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive OR with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value.

CRC-16 CALCULATIONPROCEDURE

1) Load a 16−bit register with FFFF hex (all 1's). Call this the CRC register.
2) Exclusive OR the first 8-bit byte of the message with the low-order byte of the CRC register, putting the result in the CRC register.
3) Shift the CRC register one bit to the right (toward the LSB), zero-filling the MSB. Extract and examine the LSB.
4) (If the LSB is 0): Repeat Step 3 (another shift).
   (If the LSB is 1): Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001).
5) Repeat Steps 3 and 4 until 8 shifts have been performed. When this is done, a complete 8−bit byte will have been processed.
6) Repeat Steps 2 through 5 for the next 8−bit byte of the message. Continue doing this until all bytes have been processed.
7) The final contents of the CRC register are the CRC value. Least Significant Byte first. When the 16-bit CRC (two 8-bit bytes) is transmitted in the message, the low-order byte will be transmitted first, followed by the high-order byte.

⚠NOTE: The calculating of CRC code starts from <slave address> and except for all bytes of <CRC code>.

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4.7 EXAMPLES OF INFORMATION FRAME FORMAT

4.7.1 FUNCTION CODE 03H

Slave address is 01 and starting address is 3 data of 0026H (each data with 2 bytes).

Table 11 Data Address

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

Table 12 Master Request Example

Request	Bytes	Example (Hex)	
Slave address	1	01	Send to the slave 01
Function code	1	03	Read Holding Registers
Starting address	2	00 26	Starting address is 0026H
Read numbers	2	00 03	Read 3 registers (total 6 bytes)
CRC code	2	E4 00	CRC code which calculated by PC.

Table 13 Slave Response Example

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

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4.7.2 FUNCTION CODE 05H

Read coil for slave address is 01 and starting address is 1 coil of 0002H. Set 0002H unit is 1.

Table 14 Coil Data Address

Address	Data(Hex)
0000	0
0001	1
0002	0

⚠ **NOTE: A value of FF00 hex requests the coil to be ON. A value of 00 00H requests it to be OFF. All other values are illegal and will not affect the coil.**

Table 15 Master Request Example

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

Table 16 Slave Response Example

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

4.7.3 FUNCTION CODE 06H

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

Table 17 Master Request Example

Request	Bytes	Example (Hex)	
Slave address	1	01	Send to the slave 01
Function code	1	05	Force single register
Starting address	2	00 E3	Starting address for 00E3H
Data	2	00 02	Set one point data (total 2 bytes)
CRC code	2	F9 FD	CRC code which calculated by PC.

Table 18 Slave Response Example

Slave Response	Bytes	For Example (Hex)	
Slave address	1	01	Respond to the slave 01
Function code	1	06	Force single register
Starting address	2	00 E3	Starting address is 00E3H
Data	2	00 02	Set 1 point data (total 2 bytes)
CRC code	2	F9 FD	CRC code which calculated by PC.

4.8 ERROR HANDLING

When device detected 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. The following codes show that unexpected errors have occurred.

CRC error received from the master will be ignored by the device.

Table 19 Error Code Format Responds by Slave (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.

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5. APPENDIX: ADDRESS AND DATA

5.1 FUNCTION CODE 03H, 06H MAPPING DATA FIELD

Only address 0199-0210 and address 0225-0231 can be wrote in by 06H, other addresses are unavailable.

Table 20 Function Code 03H, 06H Mapping Data Field

Address	Item	Description	Bytes
0000	Common Alarm	1 for active (LSB)	1bit
	Common Shutdown Alarm	1 for active	1bit
	Common Warning Alarm	1 for active	1bit
	Common Trip and Stop Alarm	1 for active	1bit
	Common Open Without Shutdown	1 for active	1bit
	Common Trip and Stop Alarm & Common Shutdown Alarm	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	System In Auto Mode	1 for active	1bit
	System In Manual Mode	1 for active	1bit
	System In Stop Mode	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved	(MSB)	1bit
0001	Emergency Stop Alarm	1 for active	1bit
	Over Speed Alarm Shutdown	1 for active	1bit
	Under Speed Alarm Shutdown	1 for active	1bit
	Loss of Speed Signal Alarm	1 for active	1bit
	Gen Over Frequency Alarm Shutdown	1 for active	1bit
	Gen Under Frequency Shutdown	1 for active	1bit
	Gen Over Volt Shutdown	1 for active	1bit
	Gen Under Volt Shutdown	1 for active	1bit
	Fail to Start Alarm	1 for active	1bit
	Gen Over Current Shutdown	1 for active	1bit
	Maintenance Time Due Alarm Shutdown	1 for active	1bit
	Reserved		1bit
	Reverse Power Alarm Shutdown	1 for active	1bit
	Over Power Alarm Shutdown	1 for active	1bit
	High Temp. Input Alarm Shutdown	1 for active	1bit
	Low Oil Pressure Input Alarm Shutdown	1 for active	1bit
0002	Reserved		1bit
	Low Level Input Alarm Shutdown	1 for active	1bit
	Reserved		1bit
	Reserved		1bit

Address	Item	Description	Bytes
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Temp. Sensor Open Circuit	1 for active	1bit
	High Temp. Alarm Shutdown	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Oil Pressure Sensor Open Circuit	1 for active	1bit
	Reserved		1bit
	Low Oil Pressure Alarm Shutdown	1 for active	1bit
	Reserved		1bit
0003	Level Sensor Open Circuit	1 for active	1bit
	Reserved		1bit
	Low Level Alarm Shutdown	1 for active	1bit
	Reserved		1bit
	Flexible Sensor 1 Open Circuit	1 for active	1bit
	Flexible Sensor 1 High Alarm Shutdown	1 for active	1bit
	Flexible Sensor 1 Low Alarm Shutdown	1 for active	1bit
	Reserved		1bit
	Flexible Sensor 2 Open Circuit	1 for active	1bit
	Flexible Sensor 2 High Alarm Shutdown	1 for active	1bit
	Flexible Sensor 2 Low Alarm Shutdown	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0004	Reserved		1bit
0005	Reserved		2Bytes
0006	Reserved		2Bytes
0007	Reserved		2Bytes
0008	Input 1 Shutdown	1 for active	1bit
	Input 2 Shutdown	1 for active	1bit
	Input 3 Shutdown	1 for active	1bit
	Input 4 Shutdown	1 for active	1bit
	Input 5 Shutdown	1 for active	1bit
	Input 6 Shutdown	1 for active	1bit
	Input 7 Shutdown	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit

Address	Item	Description	Bytes
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0009	Reserved		2Bytes
0010	Reserved		2Bytes
0011	Reserved		2Bytes
0012	Over Current Trip Shutdown	1 for active	1bit
	Maintenance Time Due Trip Shutdown	1 for active	1bit
	Reverse Power Trip Shutdown	1 for active	1bit
	Over Power Trip Shutdown	1 for active	1bit
	Input 1 Trip Shutdown	1 for active	1bit
	Input 2 Trip Shutdown	1 for active	1bit
	Input 3 Trip Shutdown	1 for active	1bit
	Input 4 Trip Shutdown	1 for active	1bit
	Input 5 Trip Shutdown	1 for active	1bit
	Input 6 Trip Shutdown	1 for active	1bit
	Input 7 Trip Shutdown	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0013	Reserved		2Bytes
0014	Reserved		2Bytes
0015	Reserved		2Bytes
0016	Over Current Trip	1 for active	1bit
	Maintenance Time Due Trip	1 for active	1bit
	Reverse Power Trip	1 for active	1bit
	Over Power Trip	1 for active	1bit
	Input 1 Trip	1 for active	1bit
	Input 2 Trip	1 for active	1bit
	Input 3 Trip	1 for active	1bit
	Input 4 Trip	1 for active	1bit
	Input 5 Trip	1 for active	1bit
	Input 6 Trip	1 for active	1bit
	Input 7 Trip	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0017	Reserved		1bit
0018	Reserved		1bit

Address	Item	Description	Bytes
0019	Reserved		1bit
0020	Over Speed Warning	1 for active	1bit
	Under Speed Warning	1 for active	1bit
	Loss of Speed Signal Warning	1 for active	1bit
	Gen Over Frequency Warning	1 for active	1bit
	Gen Under Frequency Warning	1 for active	1bit
	Gen Over Volt Warning	1 for active	1bit
	Gen Under Volt Warning	1 for active	1bit
	Gen Over Current Warning	1 for active	1bit
	Fail to Stop Warning	1 for active	1bit
	Fail to Charge Warning	1 for active	1bit
	Battery Over Volt Warning	1 for active	1bit
	Battery Under Volt Warning	1 for active	1bit
	Maintenance Time Due Warning	1 for active	1bit
	Reverse Power Warning	1 for active	1bit
	Over Power Warning	1 for active	1bit
	Reserved		1bit
0021	Gen Loss of Phase Warning	1 for active	1bit
	Gen Reverse Phase Sequence Warning	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Fail to Switch Warning	1 for active	1bit
	Temp. Sensor Open Circuit	1 for active	1bit
	High Temp. Warning	1 for active	1bit
	Low Temp. Warning	1 for active	1bit
	Reserved		1bit
	Oil Pressure Sensor Open Circuit	1 for active	1bit
	Reserved		1bit
	Low Oil Pressure Warning	1 for active	1bit
	Reserved		1bit
0022	Level Sensor Open Circuit	1 for active	1bit
	Reserved		1bit
	Low Level Warning	1 for active	1bit
	Reserved		1bit
	Flexible Sensor 1 Open Circuit	1 for active	1bit
	Flexible Sensor 1 High	1 for active	1bit
	Flexible Sensor 1 Low	1 for active	1bit
	Reserved		1bit
	Flexible Sensor 2 Open Circuit	1 for active	1bit
	Flexible Sensor 2 High	1 for active	1bit
	Flexible Sensor 2 Low	1 for active	1bit

Address	Item	Description	Bytes
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0023	Reserved		2Bytes
0024	Reserved		2Bytes
0025	Reserved		2Bytes
0026	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Cycle Start Comm. Failure Warning	1 for active	1bit
0027	Reserved		2Bytes
0028	Reserved		2Bytes
0029	Input 1 Warning	1 for active	1bit
	Input 2 Warning	1 for active	1bit
	Input 3 Warning	1 for active	1bit
	Input 4 Warning	1 for active	1bit
	Input 5 Warning	1 for active	1bit
	Input 6 Warning	1 for active	1bit
	Input 7 Warning	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Box Temp. High Warning	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0030	Reserved		2Bytes
0031	Alarm Shutdown Inhibit Indication	1 for active	1bit

Address	Item	Description	Bytes
	Maintenance Time Due Indication	1 for active	1bit
	In Scheduled Not Run Indication	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0032	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Auto Mode Input	1 for active	1bit
	Auto Mode Inactive	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Alt. Config. 1 Indication	1 for active	1bit
	Alt. Config. 2 Indication	1 for active	1bit
	Alt. Config. 3 Indication	1 for active	1bit
	Over Current Indication	1 for active	1bit
	Reverse Power Indication	1 for active	1bit
	Over Power Indication	1 for active	1bit
0033	Input 1 Indication	1 for active	1bit
	Input 2 Indication	1 for active	1bit
	Input 3 Indication	1 for active	1bit
	Input 4 Indication	1 for active	1bit
	Input 5 Indication	1 for active	1bit
	Input 6 Indication	1 for active	1bit
	Input 7 Indication	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit

Address	Item	Description	Bytes
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0034	Mains Normal Indication	1 for active	1bit
	Mains Abnormal Indication	1 for active	1bit
	Gen Normal Running Indication	1 for active	1bit
	Gen Shutdown Indication	1 for active	1bit
	Mains On-load Indication	1 for active	1bit
	Gen On-load Indication	1 for active	1bit
	In Auto Mode Indication	1 for active	1bit
	Not In Auto Mode Indication	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0035	Emergency Input Status	1 for active	1bit
	Input 1 Status	1 for active	1bit
	Input 2 Status	1 for active	1bit
	Input 3 Status	1 for active	1bit
	Input 4 Status	1 for active	1bit
	Input 5 Status	1 for active	1bit
	Input 6 Status	1 for active	1bit
	Input 7 Status	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0036	Reserved		2Bytes
0037	Fuel Relay Output Status	1 for active	1bit
	Starting Relay Output Status	1 for active	1bit
	Programmable Output 1 Status	1 for active	1bit
	Programmable Output 2 Status	1 for active	1bit
	Programmable Output 3 Status	1 for active	1bit
	Programmable Output 4 Status	1 for active	1bit
	Programmable Output 5 Status	1 for active	1bit
	Programmable Output 6 Status	1 for active	1bit

Address	Item	Description	Bytes
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0038	Reserved		2Bytes
0039	Reserved		2Bytes
0040	Reserved		2Bytes
0041	Reserved		2Bytes
0042	Reserved		2Bytes
0043	Mains Normal	1 for active	1bit
	Mains Closed	1 for active	1bit
	Gen Normal	1 for active	1bit
	Gen Closed	1 for active	1bit
	Alarm Indicator Status	1 for active	1bit
	Running Indicator Status	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0044	Mains Abnormal	1 for active	1bit
	Mains Over Volt	1 for active	1bit
	Mains Under Volt	1 for active	1bit
	Mains Over Frequency	1 for active	1bit
	Mains Under Frequency	1 for active	1bit
	Mains Loss Of Phase	1 for active	1bit
	Mains Reverse Phase Sequence	1 for active	1bit
	Mains Blackout	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit

Address	Item	Description	Bytes
	Reserved		1bit
0045	Input 1 Active	1 for active	1bit
	Input 2 Active	1 for active	1bit
	Input 3 Active	1 for active	1bit
	Input 4 Active	1 for active	1bit
	Input 5 Active	1 for active	1bit
	Input 6 Active	1 for active	1bit
	Input 7 Active	1 for active	1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
	Reserved		1bit
0046	Reserved		2Bytes
0047	Reserved		2Bytes
0048	Reserved		2Bytes
0049	Reserved		2Bytes
0050	Reserved		2Bytes
0051	Reserved		2Bytes
0052	Reserved		2Bytes
0053	Reserved		2Bytes
0054	Reserved		2Bytes
0055	Mains UAB	Signed	2Bytes
0056	Mains UBC	Signed	2Bytes
0057	Mains UCA	Signed	2Bytes
0058	Mains UA	Signed	2Bytes
0059	Mains UB	Signed	2Bytes
0060	Mains UC	Signed	2Bytes
0061	Mains UA Phase	Signed	2Bytes
0062	Mains UB Phase	Signed	2Bytes
0063	Mains UC Phase	Signed	2Bytes
0064	Mains Frequency	(*10)	2Bytes
0065	Reserved		2Bytes
0066	Reserved		2Bytes
0067	Reserved		2Bytes
0068	Reserved		2Bytes
0069	Reserved		2Bytes
0070	Reserved		2Bytes
0071	Reserved		2Bytes
0072	Reserved		2Bytes

Address	Item	Description	Bytes
0073	Reserved		2Bytes
0074	Reserved		2Bytes
0075	Gen UAB	Signed	2Bytes
0076	Gen UBC	Signed	2Bytes
0077	Gen UCA	Signed	2Bytes
0078	Gen UA	Signed	2Bytes
0079	Gen UB	Signed	2Bytes
0080	Gen UC	Signed	2Bytes
0081	Gen UA Phase	Signed	2Bytes
0082	Gen UB Phase	Signed	2Bytes
0083	Gen UC Phase	Signed	2Bytes
0084	Gen Frequency	(*10)	2Bytes
0085	Reserved		2Bytes
0086	Reserved		2Bytes
0087	Reserved		2Bytes
0088	Reserved		2Bytes
0089	Reserved		2Bytes
0090	Reserved		2Bytes
0091	Reserved		2Bytes
0092	Reserved		2Bytes
0093	Reserved		2Bytes
0094	Reserved		2Bytes
0095	A-Phase Current	(*10)	2Bytes
0096	B-Phase Current	(*10)	2Bytes
0097	C-Phase Current	(*10)	2Bytes
0098	Reserved		2Bytes
0099	Reserved		2Bytes
0100	Reserved		2Bytes
0101	Reserved		2Bytes
0102	Reserved		2Bytes
0103 0104	A-Phase Active Power	Signed (*10)	4Bytes
0105 0106	B-Phase Active Power	Signed (*10)	4Bytes
0107 0108	C-Phase Active Power	Signed (*10)	4Bytes
0109 0110	Total Active Power	Signed (*10)	4Bytes
0111 0112	A-Phase Reactive Power	Signed (*10)	4Bytes
0113 0114	B-Phase Reactive Power	Signed (*10)	4Bytes
0115 0116	C-Phase Reactive Power	Signed (*10)	4Bytes

Address	Item	Description	Bytes
0117 0118	Total Reactive Power	Signed (*10)	4Bytes
0119 0120	A-Phase Apparent Power	Signed (*10)	4Bytes
0121 0122	B-Phase Apparent Power	Signed (*10)	4Bytes
0123 0124	C-Phase Apparent Power	Signed (*10)	4Bytes
0125 0126	Total Apparent Power	Signed (*10)	4Bytes
0127	A-Phase Power Factor	Signed (*100)	2Bytes
0128	B-Phase Power Factor	Signed (*100)	2Bytes
0129	C-Phase Power Factor	Signed (*100)	2Bytes
0130	Average Power Factor	Signed (*100)	2Bytes
0131	Current Running Time (hour)	Unsigned	2Bytes
0132	Current Running Time (minute)	Unsigned	2Bytes
0133	Current Running Time (second)	Unsigned	2Bytes
0134 0135	Current Electric Energy	Signed (*10)	4Bytes
0136 0137	Average Power	Signed (*10)	4Bytes
0138 0139	Historical Power	Signed (*10)	4Bytes
0140	Load Percentage	Unsigned	2Bytes
0141	Engine Speed	Unsigned	2Bytes
0142	Battery Voltage	(*10)	2Bytes
0143	Charger Voltage	(*10)	2Bytes
0144	Reserved		2Bytes
0145	Reserved		2Bytes
0146	Reserved		2Bytes
0147	Reserved		2Bytes
0148	Resis. Value of Temp Sensor	Unsigned (*10)	2Bytes
0149	Temp Sensor Value	Signed	2Bytes
0150	Resis. Value of Pressure Sensor	Unsigned (*10)	2Bytes
0151	Pressure Sensor Value	Signed	2Bytes
0152	Resis. Value of Level Sensor	Unsigned (*10)	2Bytes
0153	Level Sensor Value	Signed	2Bytes
0154	Resis. Value of Flexible Sensor 1	Unsigned (*10)	2Bytes
0155	Flexible Sensor 1 Value	Signed	2Bytes
0156	Resis. Value of Flexible Sensor 2	Unsigned (*10)	2Bytes
0157	Flexible Sensor 2 Value	Signed	2Bytes
0158	Reserved		2Bytes
0159	Reserved		2Bytes
0160	Reserved		2Bytes

Address	Item	Description	Bytes
0161	Reserved		2Bytes
0162	Coolant Level		2Bytes
0163	Engine Oil Temp.		2Bytes
0164	Coolant Pressure		2Bytes
0165	Fuel Pressure		2Bytes
0166	Fuel Temp	Signed, if engine is not ECU engine, those items are reserved.	2Bytes
0167	Inlet Temp		2Bytes
0168	Outlet Temp		2Bytes
0169	Turbo Pressure		2Bytes
0170	Fuel Consumption		2Bytes
0171 0172	Total Fuel Consumption		4Bytes
0173	Reserved		2Bytes
0174	Reserved		2Bytes
0175	Reserved		2Bytes
0176	Reserved		2Bytes
0177	Reserved		2Bytes
0178	Reserved		2Bytes
0179	Reserved		2Bytes
0180	Reserved		2Bytes
0181	Reserved		2Bytes
0182	Reserved		2Bytes
0183	Reserved		2Bytes
0184	Reserved		2Bytes
0185	Reserved		2Bytes
0186	Reserved		2Bytes
0187	Reserved		2Bytes
0188	Reserved		2Bytes
0189	Generator Status	See *Generator Status*	2Bytes
0190	Gen Delay Value	Unsigned	2Bytes
0191	Remote Start Status	See *Remote Start Status*	2Bytes
0192	Remote Start Delay Value	Unsigned	2Bytes
0193	Switch Status	See *Switch Status*	2Bytes
0194	Switch Transfer Delay	Unsigned	2Bytes
0195	Mains Status	See *Mains Status*	2Bytes
0196	Mains Delay Value	Unsigned	2Bytes
0197	Reserved		2Bytes
0198	Reserved		2Bytes
0199	Total Running Time (hour)	Unsigned	2Bytes
0200	Total Running Time (minute)	Unsigned	2Bytes
0201	Total Running Time (second)	Unsigned	2Bytes
0202	Total Start Times	Unsigned	2Bytes
0203 0204	Total kWh	Signed	4Bytes

Address	Item	Description	Bytes
0205 0206	Total kvarh	Signed	4Bytes
0207 0208	Total kVAh	Signed	4Bytes
0209	Reserved		2Bytes
0210	Reserved		2Bytes
0211	Maintenance Countdown (hour)	Unsigned	2Bytes
0212	Maintenance Countdown (minute)	Unsigned	2Bytes
0213	Maintenance Countdown (second)	Unsigned	2Bytes
0214	Reserved		2Bytes
0215	Reserved		2Bytes
0216	Reserved		2Bytes
0217	Controller Model	Unsigned	2Bytes
0218	Controller Software Version	Unsigned (*10)	2Bytes
0219	Controller Hardware Version	Unsigned (*10)	2Bytes
0220	Controller Issued Time (year)	Only save last two numbers of year.	2Bytes
0221	Controller Issued Time (month)	Unsigned	2Bytes
0222	Controller Issued Time (day)	Unsigned	2Bytes
0223	Reserved		2Bytes
0224	Reserved		2Bytes
0225	Controller Time (year)	Only save last two numbers of year.	2Bytes
0226	Controller Time (month)	Unsigned	2Bytes
0227	Controller Time (day)	Unsigned	2Bytes
0228	Controller Time (week)	Unsigned	2Bytes
0229	Controller Time (hour)	Unsigned	2Bytes
0230	Controller Time (minute)	Unsigned	2Bytes
0231	Controller Time (second)	Unsigned	2Bytes
0232	Reserved		2Bytes
0233	Reserved		2Bytes
0234	Reserved		2Bytes
0235	Reserved		2Bytes
0236	Reserved		2Bytes
0237	Reserved		2Bytes
0238	Reserved		2Bytes
0239	Reserved		2Bytes
0240	Reserved		2Bytes
0241	Reserved		2Bytes
0242	Reserved		2Bytes
0243	Reserved		2Bytes
0244	Reserved		2Bytes
0245	Reserved		2Bytes
0246	Reserved		2Bytes

Address	Item	Description	Bytes
0247	Reserved		2Bytes
0248	Reserved		2Bytes
0249	Reserved		2Bytes
0250	Reserved		2Bytes
0251	Reserved		2Bytes
0252	Reserved		2Bytes
0253	Reserved		2Bytes
0254	Reserved		2Bytes
0255	Reserved		2Bytes
0256	Reserved		2Bytes
0257	Reserved		2Bytes
0258	Reserved		2Bytes
0259	Reserved		2Bytes
0260	Reserved		2Bytes
0261	Reserved		2Bytes
0262	Reserved		2Bytes
0263	Reserved		2Bytes
0264	Reserved		2Bytes
0265	Reserved		2Bytes
0266	Reserved		2Bytes
0267	Reserved		2Bytes
0268	Reserved		2Bytes
0269	Reserved		2Bytes
0270 0271	MCUID_H1	Unsigned	4Bytes
0272 0273	MCUID_H2	Unsigned	4Bytes
0274 0275	MCUID_L	Unsigned	4Bytes
0276	Reserved		2Bytes
0277	Reserved		2Bytes
0278	Reserved		2Bytes
0279	Reserved		2Bytes
0280	Reserved		2Bytes
0281	Reserved		2Bytes
0282	Reserved		2Bytes
0283	Reserved		2Bytes
0284	Reserved		2Bytes

5.2 FUNCTION CODE 05H MAP DATA FIELD

Table 21 Function Code 05H Mapping Data Field

Address	Item	Description
0000	Remote Start Key	1 for active
0001	Remote Stop Key	1 for active

Address	Item	Description	
0002	Reserved	1 for active	
0003	Remote Auto Key	1 for active	
0004	Remote Manual Key	1 for active	
0005	Remote C/O Mains Key	1 for active	HGM7120N
0006	Remote C/O Gen Key	1 for active	
0005	Remote Close Gen Key	1 for active	HGM7110N
0006	Remote Open Gen Key	1 for active	
0007	Remote "Up" Key	1 for active	
0008	Remote "Down" Key	1 for active	
0009	Remote "Left" Key	1 for active	
0010	Remote "Right" Key	1 for active	
0011	Remote Confirm Key	1 for active	
0012	Remote Mute Key	1 for active	
0013	Remote Backup Generator Start Key	1 for active (special application)	
0014	Remote Backup Generator Stop Key	1 for active (special application)	
0015	Remote Oil Engine Fast Stop	1 for active	
0016	Reserved	1 for active	
0017	Reserved	1 for active	
0018	Reserved	1 for active	
0019	Remote Control Output 1	1 for active, 0 for reactive	
0020	Remote Control Output 2	1 for active, 0 for reactive	
0021	Remote Control Output 3	1 for active, 0 for reactive	
0022	Remote Control Output 4	1 for active, 0 for reactive	
0023	Remote Control Output 5	1 for active, 0 for reactive	
0024	Remote Control Output 6	1 for active, 0 for reactive	
0025	Reserved	1 for active	
0026	Reserved	1 for active	
0027	Reserved	1 for active	
0028	Reserved	1 for active	
0029	Reserved	1 for active	
0030	Remote Lock/Unlock	1 for lock, 0 for unlock	

5.3 GENERATOR STATUS

Table 22 Generator Status

No.	Content	Description
0	Standby	There is no delay in this status
1	Pre-heat	
2	Fuel Output	There is no delay in this status
3	Crank	
4	Crank Interval	
5	Safety On Delay	
6	Start Idle	
7	Warming Up	

No.	Content	Description
8	Waiting for Load	There is no delay in this status
9	Normal Running	There is no delay in this status
10	Cooling	
11	Stop Idle	
12	ETS	
13	Waiting for Stop	
14	Fail to Stop	There is no delay in this status
15	After Stop	

5.4 REMOTE START STATUS

Table 23 Remote Start Status

No.	Content	Description
0	No Delay	There is no delay in this status
1	Start Delay	
2	Stop Delay	

5.5 SWITCH STATUS

Table 24 Switch Status

No.	Content	Description
0	Off Load	There is no delay in this status
1	Mains On-load	There is no delay in this status
2	Gen On-load	There is no delay in this status
3	Open Delay	
4	Switch Transfer Delay	
5	Mains Close Delay	
6	Gen Close Delay	
7	Waiting for Breaker Open	There is no delay in this status
8	Waiting for Gen Close	There is no delay in this status
9	Waiting for Mains Close	There is no delay in this status
10	Normal	There is no delay in this status

5.6 MAINS STATUS

Table 25 Mains Status

No.	Content	Description
0	Mains Normal	There is no delay in this status
1	Mains Normal Delay	
2	Mains Abnormal	There is no delay in this status
3	Mains Abnormal Delay	

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