SmartGen

MAKING CONTROL SMARTER

HGM8140/HGM8140Z

GENSET CONTROLLER

COMMUNICATION PROTOCOL

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Table 1 Software Version

Date	Version	Content
2019-03-27	1.0	Original release.
2020-09-17	1.1	Add unit and related data note for 03 function code monitoring data.
2023-04-20	1.2	Modify it with the latest template.

CONTENT

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.

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).

The controller has 1 RS485 port, which can be used as the slave, using Modbus-RTU protocol, and does not support other protocols such as Modbus-ASCII.

Modbus basic rules:

— All RS485 communication loops should follow the master-slave mode. If so, data can be transferred between a master (e.g. PC) and 32 slaves;

— The master will initialize all the information transmitted by the device on the communication loop;

— No communication can start from slaves;

— In communication loop, all communication should be transmitted in the way of “information frame”;

— If the master and slaves receive information frame with unknown command, they shall not respond.

Data format:
Communication address: 1~254 (default: 1)
Baud rate: 9600bps
Start bit: 1-bit
Data bit: 8-bit
Parity bit: None, odd parity, even parity (default: none)
Stop bit: 1-bit, 2-bit can be set

Supported function code: 01H, 03H, 05H, 06H. Function code 01H is used for reading single or multiple coils; 03H is used for reading controller alarm, status information and various power data; 05H is used for saving single coil data to the bit memory inside the device, 06H is used for saving single data to the memory inside the device.

Data calibration method: CRC16.

When communication command is sent to the instrument, the instrument with corresponding address code shall receive it, and then remove the address code, read the information. If nothing goes wrong, it shall execute the command, and send the result back to the sender. The backward information includes address code, function code for action execution, data after the action execution and error check code (CRC). If an error occurs, no information is sent.

Internal registers of controller are in the unit of “byte (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 line.

Once maximum 120 data of byte register can be read.

Up to 32 controllers can be deployed for network communication.

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

2. WIRING DIAGRAM

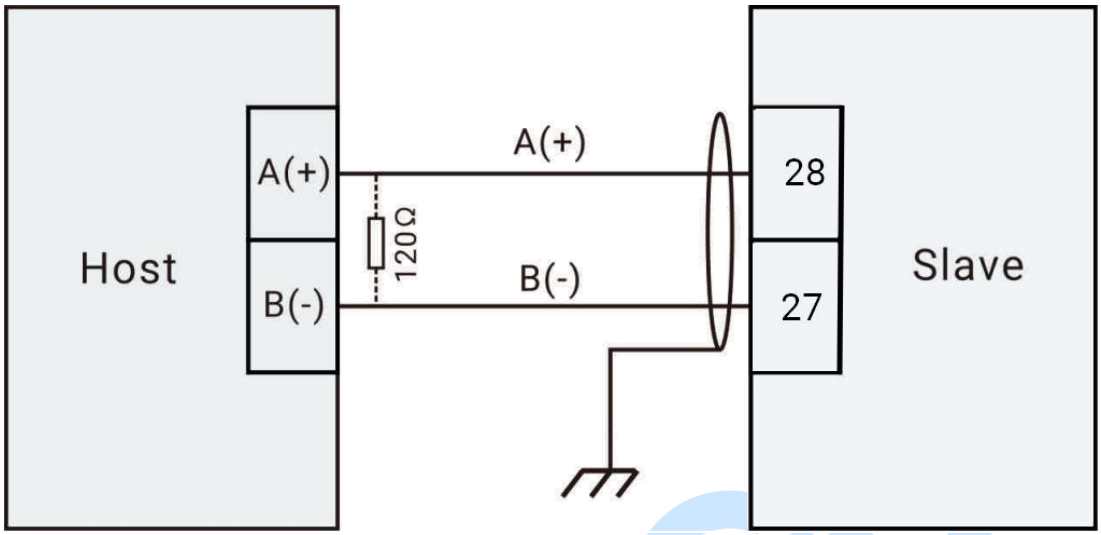

Fig.1 Single Unit Communication Wiring Diagram

NOTE1: 2 120Ω impedance resistors can be connected automatically according to site situation, details refer to the following description.

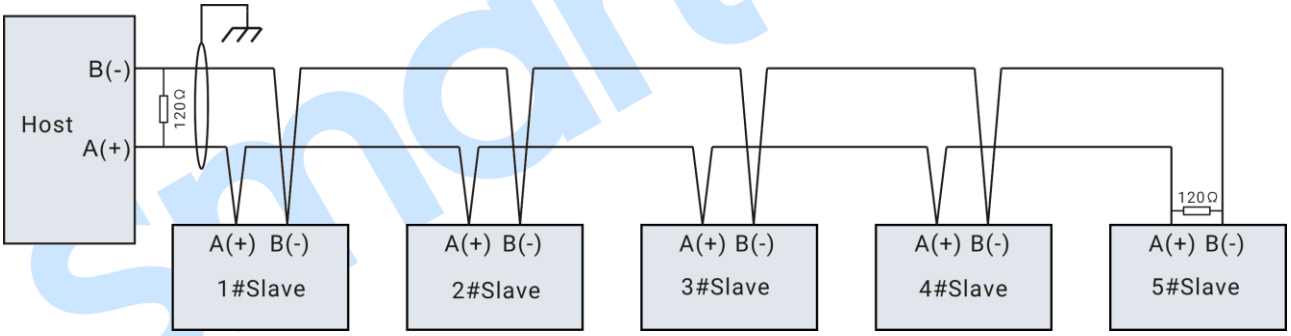

Fig.2 Multi-unit Communication Wiring Diagram

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

NOTE2: The shielding layer of communication line is single-end grounded on the host side.

3. CONTROLLER INTERNAL REGISTER ADDRESS AND DATA

3.1 FUNCTION CODE 01H MAPPLING COIL FIELD

Table 2 Alarm, Status Coil Data Field

Modbus Address	PLC Address	Item	Description
0000	0001	Common Alarm	0 represents there is no common alarm; 1 represents there is common alarm, and so on.
0001	0002	Common Warning Alarm	1 for active
0002	0003	Common Shutdown Alarm	1 for active
0003	0004	Idle Mode	1 for active
0004	0005	Common Trip and Stop	1 for active
0005	0006	Common Trip	1 for active
0006	0007	Common Trip and Stop & Common Trip Alarm	1 for active
0007	0008	Gen On-load	1 for active
0008	0009	Emergency Stop	1 for active
0009	0010	Overspeed Alarm Shutdown	1 for active
0010	0011	Underspeed Alarm Shutdown	1 for active
0011	0012	Speed Signal Loss Shutdown	1 for active
0012	0013	Overfrequency Alarm Shutdown	1 for active
0013	0014	Underfrequency Alarm Shutdown	1 for active
0014	0015	Overvoltage Alarm Shutdown	1 for active
0015	0016	Undervoltage Alarm Shutdown	1 for active
0016	0017	Gen Overcurrent Shutdown	1 for active
0017	0018	Crank Failure	1 for active
0018	0019	High Water Temp. Alarm Shutdown	1 for active
0019	0020	Low Oil Pressure Alarm Shutdown	1 for active
0020	0021	Frequency Loss Alarm	1 for active
0021	0022	Input Shutdown Alarm	1 for active
0022	0023	Low Fuel Level Shutdown Alarm	1 for active
0023	0024	Low Coolant Level Shutdown Alarm	1 for active
0024	0025	High Water Temp. Warning Alarm	1 for active
0025	0026	Low Oil Pressure Warning Alarm	1 for active
0026	0027	Gen Overcurrent Warning Alarm	1 for active
0027	0028	Stop Failure Warning Alarm	1 for active

Modbus Address	PLC Address	Item	Description
0028	0029	Low Fuel Level Warning	1 for active
0029	0030	Charging Failure Warning	1 for active
0030	0031	Battery Undervoltage Warning Alarm	1 for active
0031	0032	Battery Overvoltage Warning Alarm	1 for active
0032	0033	Input Warning Alarm	1 for active
0033	0034	Speed Signal Loss Warning	1 for active
0034	0035	Low Coolant Level Warning	1 for active
0035	0036	Temp. Sensor Open Warning	1 for active
0036	0037	Oil Pressure Sensor Open Warning	1 for active
0037	0038	Maintenance Time Due Warning	1 for active
0038	0039	Charger Fail to Charge Warning	1 for active
0039	0040	Overpower Warning	1 for active
0040	0041	War Mode	1 for active
0041	0042	Auto Mode	1 for active
0042	0043	Manual Mode	1 for active
0043	0044	Stop Mode	1 for active
0044	0045	Temp. Sensor Open Shutdown	1 for active
0045	0046	Oil Pressure Sensor Open Shutdown	1 for active
0046	0047	Maintenance Time Due Shutdown Alarm	1 for active
0047	0048	Overpower Shutdown Alarm	1 for active
0048	0049	Emergency Stop Input	1 for active
0049	0050	Aux. Input 1	1 for active
0050	0051	Aux. Input 2	1 for active
0051	0052	Aux. Input 3	1 for active
0052	0053	Aux. Input 4	1 for active
0053	0054	Aux. Input 5	1 for active
0054	0055	Aux. Input 6	1 for active
0055	0056	Reserved	1 for active
0056	0057	Crank Relay Output	1 for active
0057	0058	Fuel Relay Output	1 for active
0058	0059	Aux. Output 1	1 for active
0059	0060	Aux. Output 2	1 for active
0060	0061	Aux. Output 3	1 for active
0061	0062	Aux. Output 4	1 for active
0062	0063	Aux. Output 5	1 for active
0063	0064	Reserved	1 for active
0064	0065	Reserved	1 for active
0065	0066	Reserved	1 for active

Modbus Address	PLC Address	Item	Description
0066	0067	Reserved	1 for active
0067	0068	Reserved	1 for active
0068	0069	Reserved	1 for active
0069	0070	Reserved	1 for active
0070	0071	Reserved	1 for active
0071	0072	Reserved	1 for active
0072	0073	Gen Normal	1 for active
0073	0074	Gen Overvoltage	1 for active
0074	0075	Gen Undervoltage	1 for active
0075	0076	Gen Overfrequency	1 for active
0076	0077	Gen Underfrequency	1 for active
0077	0078	Gen Overcurrent Warning	1 for active
0078	0079	Scheduled Not Run	1 for active
0079	0080	ECU Warning	1 for active
0080	0081	ECU Shutdown Alarm	1 for active
0081	0082	ECU Comm. Failure Shutdown	1 for active
0082	0083	Reverse Power Shutdown Alarm	1 for active
0083	0084	Reserved	1 for active
0084	0085	Reserved	1 for active
0085	0086	Reserved	1 for active
0086	0087	Reserved	1 for active
0087	0088	Reserved	1 for active
0088	0089	Sensor 4 Open Shutdown Alarm	1 for active
0089	0090	Sensor 4 High Shutdown Alarm	1 for active
0090	0091	Sensor 4 Low Shutdown Alarm	1 for active
0091	0092	High Water Temp. Shutdown Alarm Input	1 for active
0092	0093	Low Oil Pressure Shutdown Alarm Input	1 for active
0093	0094	Reserved	1 for active
0094	0095	Reserved	1 for active
0095	0096	Reserved	1 for active
0096	0097	Input 1 Shutdown Alarm	1 for active
0097	0098	Input 2 Shutdown Alarm	1 for active
0098	0099	Input 3 Shutdown Alarm	1 for active
0099	0100	Input 4 Shutdown Alarm	1 for active
0100	0101	Input 5 Shutdown Alarm	1 for active
0101	0102	Input 6 Shutdown Alarm	1 for active
0102	0103	Reserved	1 for active
0103	0104	Reserved	1 for active
0104	0105	Comm. Failure Warning on RS232 Port	1 for active
0105	0106	Comm. Failure Warning on CAN	1 for active

Modbus Address	PLC Address	Item	Description
		Expansion Display 1	
0106	0107	Comm. Failure Warning on CAN Expansion Display 2	1 for active
0107	0108	Comm. Failure Warning on CAN Expansion Display 3	1 for active
0108	0109	Reserved	1 for active
0109	0110	Reserved	1 for active
0110	0111	Reserved	1 for active
0111	0112	Reserved	1 for active
0112	0113	Sensor 4 Open Warning Alarm	1 for active
0113	0114	Sensor 4 High Warning Alarm	1 for active
0114	0115	Sensor 4 Low Warning Alarm	1 for active
0115	0116	Reverse Power Warning Alarm	1 for active
0116	0117	High Water Temp. Warning Alarm	1 for active
0117	0118	Low Oil Pressure Warning Alarm	1 for active
0118	0119	Reserved	1 for active
0119	0120	Reserved	1 for active
0120	0121	Input 1 Warning Alarm	1 for active
0121	0122	Input 2 Warning Alarm	1 for active
0122	0123	Input 3 Warning Alarm	1 for active
0123	0124	Input 4 Warning Alarm	1 for active
0124	0125	Input 5 Warning Alarm	1 for active
0125	0126	Input 6 Warning Alarm	1 for active
0126	0127	Reserved	1 for active
0127	0128	Reserved	1 for active
0128	0129	Reserved	1 for active
0129	0130	Reserved	1 for active
0130	0131	Reserved	1 for active
0131	0132	Reserved	1 for active
0132	0133	Reserved	1 for active
0133	0134	Reserved	1 for active
0134	0135	Reserved	1 for active
0135	0136	Reserved	1 for active
0136	0137	Reserved	1 for active
0137	0138	Reserved	1 for active
0138	0139	Reserved	1 for active
0139	0140	Reserved	1 for active
0140	0141	Reserved	1 for active
0141	0142	Reserved	1 for active
0142	0143	Reserved	1 for active
0143	0144	Reserved	1 for active
0144	0145	Overcurrent Trip and Stop	1 for active

Modbus Address	PLC Address	Item	Description
0145	0146	Maintenance Time Due Trip and Stop	1 for active
0146	0147	Reverse Power Trip and Stop	1 for active
0147	0148	Overpower Trip and Stop	1 for active
0148	0149	Input 1 Trip and Stop	1 for active
0149	0150	Input 2 Trip and Stop	1 for active
0150	0151	Input 3 Trip and Stop	1 for active
0151	0152	Input 4 Trip and Stop	1 for active
0152	0153	Input 5 Trip and Stop	1 for active
0153	0154	Input 6 Trip and Stop	1 for active
0154	0155	Reserved	1 for active
0155	0156	Reserved	1 for active
0156	0157	Reserved	1 for active
0157	0158	Reserved	1 for active
0158	0159	Reserved	1 for active
0159	0160	Reserved	1 for active
0160	0161	Overcurrent Trip	1 for active
0161	0162	Maintenance Time Due Trip	1 for active
0162	0163	Reverse Power Trip	1 for active
0163	0164	Overpower Trip	1 for active
0164	0165	Input 1 Trip	1 for active
0165	0166	Input 2 Trip	1 for active
0166	0167	Input 3 Trip	1 for active
0167	0168	Input 4 Trip	1 for active
0168	0169	Input 5 Trip	1 for active
0169	0170	Input 6 Trip	1 for active
0170	0171	Reserved	1 for active
0171	0172	Reserved	1 for active
0172	0173	Reserved	1 for active
0173	0174	Reserved	1 for active
0174	0175	Reserved	1 for active
0175	0176	Reserved	1 for active

Example:

Read 1CH (decimal 28) coils of starting address 0000H.

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

Table 3 Master Request Command

Slave Address	Function Code	Starting Address (0000)		Request Data Qty. (28)		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**01**	**00**	**00**	**00**	**1C**	**3D**	**C3**

The slave response command is as following:

Table 4 Slave Response Command

Slave Address	Function Code	Data Qty. (Bytes)	Data				CRC 16 Calibration	
			Content of Address 07—00	Content of Address 0F—08	Content of Address 17—10	Content of Address 1C—18	LSB	MSB
01	**01**	**04**	**30**	**00**	**93**	**0A**	**18**	**26**

Coil 07—00 expressed as 30H of hex and 00110000 of binary, coil 07 is high bit and 00 is low bit. Coil 07—00 status is: OFF—OFF—ON—ON—OFF—OFF—OFF—OFF.

3.2 FUNCTION CODE 03H, 06H MAPPING DATA FIELD

06 function code only can be written for address 72-77, other addresses are unavailable.

Table 5 Function Coe 03H, 06H Mapping Data Field

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0000	40001	Reserved				Unsigned	2Bytes
0001	40002	Reserved				Unsigned	2Bytes
0002	40003	Reserved				Unsigned	2Bytes
0003	40004	Reserved				Unsigned	2Bytes
0004	40005	Reserved				Unsigned	2Bytes
0005	40006	Reserved				Unsigned	2Bytes
0006	40007	Reserved				Unsigned	2Bytes
0007	40008	Gen UA	0~65535	1	V	Unsigned	2Bytes
0008	40009	Gen UB	0~65535	1	V	Unsigned	2Bytes
0009	40010	Gen UC	0~65535	1	V	Unsigned	2Bytes
0010	40011	Gen UAB	0~65535	1	V	Unsigned	2Bytes
0011	40012	Gen UBC	0~65535	1	V	Unsigned	2Bytes
0012	40013	Gen UCA	0~65535	1	V	Unsigned	2Bytes
0013	40014	Gen Freq.	0~100.0	0.1	Hz	Unsigned NOTE1	2Bytes
0014	40015	A Phase Current	0~65535	0.1	A	Unsigned	2Bytes
0015	40016	B Phase Current	0~65535	0.1	A	Unsigned	2Bytes
0016	40017	C Phase Current	0~65535	0.1	A	Unsigned	2Bytes
0017	40018	Water Temp. Value	0~65535		℃	Unsigned	2Bytes NOTE7
0018	40019	Water Temp. Resist. Value	0~65535	0.1	Ω	Unsigned NOTE1	2Bytes
0019	40020	OP Value	0~65535		kPa	Unsigned	2Bytes NOTE7
0020	40021	OP Resist. Value	0~65535	0.1	Ω	Unsigned NOTE1	2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
0021	40022	Level Value	0~65535		%	Unsigned	2Bytes NOTE7
0022	40023	Level Resist. Value	0~65535	0.1	Ω	Unsigned NOTE1	2Bytes
0023	40024	Speed	0~65535	1	RPM	Unsigned NOTE1	2Bytes
0024	40025	Battery Voltage	0~65535	0.1	V	Unsigned NOTE1	2Bytes
0025	40026	D+ Voltage	0~65535	0.1	V	Unsigned NOTE1	2Bytes
0026	40027	Active Power	0~65535	0.1	kW	Unsigned	2Bytes
0027	40028	Reactive Power	-32768~32767	0.1	kvar	Signed	2Bytes
0028	40029	Apparent Power	0~65535	0.1	kVA	Unsigned NOTE2	2Bytes
0029	40030	Power Factor	0~65535	0.01	Cos Φ	Unsigned	2Bytes
0030	40031	Maintenance Countdown h	0~5000	1	h	Unsigned	2Bytes
0031	40032	Maintenance Countdown min	0~59	1	min	Unsigned	2Bytes
0032	40033	Reserved				Unsigned	2Bytes
0033	40034	Current Running Hour	0~65535	1	h	Unsigned	2Bytes NOTE3
0034	40035	Controller Running Table: Genset Status				Unsigned	2Bytes
0035	40036	Genset Delay	0~3600	1	s	Unsigned	2Bytes
0036	40037	Auto Running Status 0 Start 1 Stop 2 No Delay				Unsigned	2Bytes
0037	40038	Auto Delay			s	Unsigned	2Bytes
0038	40039	ATS Running Status 0 No Delay 1 Transfer Rest				Unsigned	2Bytes

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark	
0039	40040	ATS Delay			s	Unsigned	2Bytes	
0040	40041	Mains Status 0 Normal 1 Abnormal 2 No Delay				Unsigned	2Bytes	
0041	40042	Mains Delay	0~3600	1	s	Unsigned	2Bytes	
0042	40043	Accum. Oil Engine Running Time (h) MSB	0~9000	1	h	Unsigned	2Bytes	NOTE4
0043	40044	Accum. Oil Engine Running Time (h) LSB	0~9999	1	h	Unsigned	2Bytes	
0044	40045	Accum. Oil Engine Running Time (min)	0~59	1	min	Unsigned	2Bytes	NOTE4
0045	40046	Accum. Oil Engine Running Time (s)	0~59	1	s	Unsigned	2Bytes	
0046	40047	Accum. Start Times MSB	0~9000	1		Unsigned	2Bytes	NOTE4
0047	40048	Accum. Start Times LSB	0~9999	1		Unsigned	2Bytes	
0048	40049	Accum. Energy MSB	0~9000	1	kWh	Unsigned	2Bytes	NOTE4
0049	40050	Accum. Energy LSB	0~9999	1	kWh	Unsigned	2Bytes	
0050	40051	SW				Unsigned	2Bytes	
0051	40052	HW				Unsigned	2Bytes	
0052	40053	A Phase Active Power	-32768~32767	0.1	kW	Signed	2Bytes	
0053	40054	B Phase Active Power	-32768~32767	0.1	kW	Signed	2Bytes	
0054	40055	C Phase Active Power	-32768~32767	0.1	kW	Signed	2Bytes	
0055	40056	Load Output Percentage	-100~100	1	%	Unsigned	2Bytes	
0056	40057	Current Running	0~59	1	min	Unsigned	2Bytes NOTE3	

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description		Remark	
		Minutes							
0057	40058	Current Running Seconds	0~59	1	s	Unsigned		2Bytes NOTE3	
0058	40059	Coolant Level	0~100	1	%	Signed	Signed, it is reserved when engine is not ECU. NOTE 7	2Bytes	NOTE1
0059	40060	Oil Temp.	-32768~32767	1	℃	Signed		2Bytes	
0060	40061	Coolant Pressure	-32768~32767	1	kPa	Signed		2Bytes	
0061	40062	Fuel Pressure	-32768~32767	1	kPa	Signed		2Bytes	
0062	40063	Fuel Temp.	-32768~32767	1	℃	Signed		2Bytes	
0063	40064	Inlet Temp.	-32768~32767	1	℃	Signed		2Bytes	
0064	40065	Exhaust Temp.	-32768~32767	1	℃	Signed		2Bytes	
0065	40066	Turbo Pressure	-32768~32767	1	kPa	Signed		2Bytes	
0066	40067	Fuel Consump.	0~65535	0.1	L	Signed		2Bytes	
0067	40068	Battery Left Capacity	0~100	1	%	Unsigned		2Bytes NOTE3	
0068	40069	Accum. Fuel Consump.	0~2147483647	1	L	Signed		2Bytes	LSB
0069	40070							2Bytes	MSB
0070	40071	SCM Internal Temp.	-32768~32767	1	℃	Signed		2Bytes	
0071	40072	Controller Model				Signed		2Bytes	
0072	40073	Controller Time: Year	0~99	1		Unsigned		2Bytes	
0073	40074	Controller Time: Month	1~12	1		Unsigned		2Bytes	
0074	40075	Controller Time: Day	1~31	1		Unsigned		2Bytes	
0075	40076	Controller Time: Week	0~6	1		Unsigned		2Bytes	
0076	40077	Controller Time: h	0~23	1	h	Unsigned		2Bytes	
0077	40078	Controller	0~59	1	min	Unsigned		2Bytes	

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Time: min					
0078	40079	Controller Time: s	0~59	1	s	Unsigned	2Bytes
0079	40080	Release Year	0~99	1		Unsigned	2Bytes
0080	40081	Release Month	1~12	1		Unsigned	2Bytes
0081	40082	Release Day	1~31	1		Unsigned	2Bytes
0082	40083	Reserved					
0083	40084	Reserved					
0084	40085	Reserved					
0085	40086	Reserved					
0086	40087	mtuHours				Unsigned (ECU type is ADEC_SAM)	2Bytes LSB
0087	40088					Unsigned	2Bytes MSB
0088	40089	mtuFc				Unsigned	2Bytes
0089	40090	mtuDroop				Unsigned	2Bytes
0090	40091	mtuSpeedDemand				Unsigned	2Bytes
0091	40092	mtuSSD				Unsigned	2Bytes
0092	40093	Gen UA Phase	0~360	1	°	Unsigned	2Bytes
0093	40094	Gen UB Phase	0~360	1	°	Unsigned	2Bytes
0094	40095	Gen UC Phase	0~360	1	°	Unsigned	2Bytes
0095	40096	Reserved				Unsigned	2Bytes
0096	40097	Reserved				Unsigned	2Bytes
0097	40098	Reserved				Unsigned	2Bytes
0098	40099	A Phase Power Factor	-10000~10000	0.01		Signed NOTE2	2Bytes
0099	40100	B Phase Power Factor	-10000~10000	0.01		Signed NOTE2	2Bytes
00100	40101	C Phase Power Factor	-10000~10000	0.01		Signed NOTE2	2Bytes
00101	40102	A Phase Reactive	-32768~32767	0.1	kvar	Signed	2Bytes

NOTE5

Modbus Address	PLC Address	Item	Range (Decimal)	Ratio	Unit	Description	Remark
		Power					
00102	40103	B Phase Reactive Power	-32768~32767	0.1	kvar	Signed	2Bytes
00103	40104	C Phase Reactive	-32768~32767	0.1	kvar	Signed	2Bytes
00104	40105	A Phase Apparent Power	-32768~32767	0.1	kVA	Signed	2Bytes
00105	40106	B Phase Apparent Power	-32768~32767	0.1	kVA	Signed	2Bytes
00106	40107	C Phase Apparent Power	-32768~32767	0.1	kVA	Signed	2Bytes
00107	40108	Sensor COM				Unsigned	2Bytes
00108	40109	Aux. Sensor 4 Resist. Value	0~65535	0.1	Ω	Unsigned	2Bytes
00109	40110	Aux. Sensor 4 Value	-32768~32767			Signed	2Bytes
00110	40111	Battery Pack Voltage Value	0~65535	0.1	V	Unsigned	2Bytes
00111	40112	MCUID_H1				Unsigned	2Bytes LSB
00112	40113						2Bytes MSB
00113	40114	MCUID_H2 NOTE6				Unsigned	2Bytes LSB
00114	40115						2Bytes MSB
00115	40116	MCUID_L				Unsigned	2Bytes LSB
00116	40117						2Bytes MSB
00117	40118	Reserved					2Bytes
00118	40119	Reserved					2Bytes
00119	40120	Reserved					2Bytes
00120	40121	Reserved					2Bytes

NOTE1: Ratio 0.1 represents that there is one decimal point for read data. For example, read gen frequency value is 501 (decimal), the actual value is 50.1Hz.

NOTE2: Ratio 0.01 represents that there are two decimal points for read data. For example, read power factor value is 100 (decimal), the actual value is 1.00.

NOTE3: These parameters are only available for HGM8140-3T.

NOTE4: Value=MSB*65536+LSB. For example, accum. oil engine running time (h)= accum. oil engine running time (h) MSB*65536+ accum. oil engine running time (h) LSB.

NOTE5: If not detect corresponding phase sequence, data will be 32766, "####" will be displayed.

NOTE6: MUC ID number is 96-bit, and this ID number is combined by MCUID_H1(32-bit), MCUID_H2(32-bit), MCUID_L(32-bit).

NOTE7: When controller detects sensor is open, data will be 32766, "++++" will be displayed; if ECU doesn't receive sensor information, data will be 32767, "####" will be displayed; the unit of aux. sensor is defined by corresponding sensor type.

Example:

Read "Accum. Fuel Consump. (current is 123456)", firstly get its address is 0068 and 0069 by checking the table, then it is known that you need to read 2 bytes' data.

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

Table 6 Master Request Command

Slave Address	Function Code	Starting Address (0068)		Request Data Qty. (2)		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**03**	**00**	**44**	**00**	**02**	**84**	**1E**

The slave response command is as following:

Table 7 Slave Response Command

Slave Address	Function Code	Data Qty. (Bytes)	Data				CRC 16 Calibration	
			Data MSB of Address 0068	Data LSB of Address 0068	Data MSB of Address 0069	Data LSB of Address 0069	LSB	MSB
01	**03**	**04**	**E2**	**40**	**00**	**01**	**0C**	**5F**

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

Table 8 Data Analysis

Address	Received Data (Hex)	After Combination (Hex)	Accum. Fuel Consump. (Decimal)
0103	E240H	0001E240H	123456
0104	0001H		

3.3 FUNCTION CODE 05H MAPPING COIL FIELD

Table 9 Remote Coil Field

Modbus Address	PLC Address	Item	Description
0000	0001	Remote Oil Engine in Start Status	1 for active
0001	0002	Remote Oil Engine in Stop Status	1 for active
0002	0003	/	1 for active
0003	0004	Remote Oil Engine in Auto Status	1 for active
0004	0005	Remote Oil Engine in Manual Status	1 for active
0005	0006	Remote Gen Close/Open	1 for active
0006	0007	/	1 for active

NOTE: The above remote command only can be sent once only.

Example:

Remote control controller to work in manual mode, firstly get its remote address is 0004.

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

Table 10 Master Request Command

Slave Address	Function Code	Remote Address (0004)		Remote Data		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**05**	**00**	**04**	**00**	**FF**	**CC**	**4B**

The slave response command is as following:

Table 11 Slave Response Command

Slave Address	Function Code	Remote Address (0004)		Remote Data		CRC 16 Calibration	
		MSB	LSB	MSB	LSB	LSB	MSB
01	**05**	**00**	**04**	**00**	**FF**	**CC**	**4B**

Whether the remote command is successfully executed can be verified by reading the manual mode status of address 0042 via function code 01H.

3.4 ERROR HANDLING

When the 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. The following codes show that unexpected errors have occurred.

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

Table 12 Error Code Format Responded 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.

3.5 ERROR CHECK CODE (CRC)

By Error Check Code the master or slave can detect whether the receiving information is right or not. Sometimes, due to electronic noise or other interference, the information may change in the transmission process and CRC code ensures the error information does not work in the transmission process. It increases the system's safety and efficiency. CRC code adopts CRC-16 calibration method.

CRC code of 2 bytes is front low byte and behind high byte.

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

Cyclic Redundancy Check (CRC) contains two bytes. That is a 16-bit binary value. The CRC code is calculated by the transmitting device, and placed at the end of the transmitted information. The receiving device recalculates the CRC code of the receiving information. If the two values are different, then something goes wrong.

CRC code computing method is: first put the 16-bit register all to “1”; and then handle the 8-bit data information each gradually. In the process of computing the CRC code only 8 data bit is used and he start bit and stop bit are not included in it.

In the process of computing the CRC code, each 8–bit data is exclusive OR with the register data; and the result obtained moves 1 bit to the least significant bit (LSB), then use 0 to make up for the most significant bit (MSB). Then the LSB is examined. If the LSB was 1, the register content is then exclusive OR with a preset fixed value. If the LSB was 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 times 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 Code Calculation Procedure:

1) Make 16-bit CRC register as hexadecimal FFFF;
2) Make the first 8-bit byte exclusive ORed with the low–order byte of the CRC register, and put the result in the CRC register;
3) Shift the CRC register one bit to the right, with a zero filled into the MSB. The LSB is extracted and examined.
4) If the LSB was 0: Repeat Step 3 (another shift).
   If the LSB was 1: CRC register exclusive ORed with the A001 hexadecimal;
5) Repeat Step 3 and 4 until 8 shifts have been performed. In this way eight shifts have been performed;
6) Repeat Step 2 to 5 and perform the next data handling process;
7) The final contents of the CRC register are the CRC value. When the CRC is appended to the message, the low-order 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 calculation of CRC code starts from <slave address>, exclusive of all bytes of <CRC code>.

3.6 GENSET STATUS

Table 13 Genset Status

No.	Item	Description
0	Standby	No delay value for this status
1	Preheat	
2	Fuel Output	No delay value for this status
3	Crank	
4	Crank Rest	
5	Safety Run	
6	Start Idle	
7	High Speed Warming Up	
8	Wait for Load	No delay value for this status
9	Normal Running	No delay value for this status
10	High Speed Cooling	
11	Stop Idle	
12	ETS	
13	Wait for Stop	
14	Stop Failure	No delay value for this status

4. COMMUNICATION PARAMETER VIEWING AND CONFIGURATION

1) In the homepage of main interface, press key to enter menu interface;
2) Press Down key to select “Parameter Setting”, then press key to enter parameter password interface;
3) Input correct password (default 0318), press key to enter the main interface of parameter;
4) Select “Controller Address” via , key, Press key to enter parameter edit function, corresponding parameters will be in the selected status;
5) Set the current selected content via , key, then press key to confirm, after editing, then the selected status will disappear;
6) Long press key to return the main interface.

NOTE: After parameter setting is completed, the configuration takes effect.

5. FAQ

5.1 COMMUNICATION LINE SHIELDING LAYER GROUNDED

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

5.2 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.

5.3 RS485 TO USB COMMUNICATION ADAPTOR

PC can communicate with SG72A module produced by our company.

5.4 EXTENDED COMMUNICATION DISTANCE

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

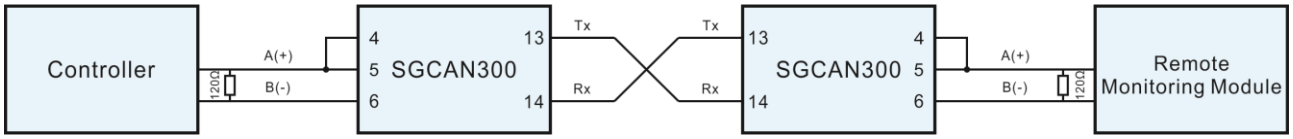

Fig.3 SGCAN300 Application Diagram

5.5 COMMON SOLUTIONS OF COMMUNICATION FAILURE

1) Check whether the positive and negative of RS485 is correctly connected;
2) Check whether the communication parameter in parameter setting is correct;
3) Check whether the RS485 converter (if configured) is normal;
4) Check whether the terminal resistor is correctly connected;
5) Disconnect the connection line of controller's RS485, measure the voltage difference of RS485's A and B terminal. If the difference is between ±200mV, it means communication port has abnormal situation;
6) It is recommended to download third-party communication software such as modscan32, modbus poll to check whether communication is normal.