

## 1. Brief Introduction of Modbus Protocol

Communication between Afore inverter and upper computer follows Modbus RTU protocol

### 1) Message format

Table 1 Message format

Address	Function code	Data	CRC	
1byte	1byte	1-252 bytes	Low byte	High byte

About function code: 0x03 - Read Hold register, 0x04 - Read Input register, 0x06 - Write single register

### 2) Endian

Table 2 Endian

Start bit	Data								Stop bit
1	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7	1

### 3) Query and response

There are normal response and exception, exception defined as following:

Table 3 Exception

Exception code	Exception	Note
0x01	Invalid function code	Invalid function code
0x02	Invalid data address	Address and data length not match
0x03	Invalid data	Data out of range

a) Read Hold and Input register

Table 4 Query and response

Query	Response	exception
Address	Address	Address
Function code (0x03/0x04)	Function code (0x03/0x04)	Fault code (0x83/0x84)
Start address A high byte	Data Length (bytes)	<a href="#">Exception</a>
Start address A low byte	A Data high byte	CRC low byte
Register Num. N high byte	A Data low byte	CRC high byte
Register Num. N low byte	.....	
CRC low byte	A+N-1 Data high byte	
CRC high byte	A+N-1 Data low byte	
	CRC low byte	
	CRC high byte	

b) Write single register

Table 5 Write single register and response

Query	Normal response	Exception
Address	Address	Address
Function code (0x06)	Function code (0x06)	Fault code(0x86)
Register address high byte	Register address high byte	Register address high byte
Register address low byte	Register address low byte	Register address low byte
Set value high byte	Set value high byte	<a href="#">Exception</a>
Set value low byte	Set value low byte	CRC low byte
CRC low byte	CRC low byte	CRC high byte
CRC high byte	CRC high byte	

## 2. Communication configuration

- 1) Physical interface : RS-485
- 2) Serial communication interface
- 3) Baud rate : 9600bps
- 4) On start bit, 8 data bits, no parity check, one stop bit
- 5) Minimum query period : 1s
- 6) Register length : 2 Bytes
- 7) Big endian , for unsigned int 0x01 0x02, parsing as 0x0102=258 for unsigned long 0x01 0x02 0x03 0x04, parsing as 0x01020304=16909060

## 3. Register map

### 1) Input register

Input register is to store the running data of Afore inverter which is only readable, written is not allowed. The function code of reading input register is 0x04.

Table 7 Input register map

Input Addr	Item	Unit	Range	Note
0	State		0-65535	Bit0: reserved Bit1: PowerDown Bit2-7: reserved Bit8: Inverter starts to work (work 1 and vice versa) Bit9: grid-connected generation (generation is 1 and vice versa) Bit10: grid is normal (normal is 1, otherwise 0) Bit11-12: reserved Bit13: Inverter Run or Stop
1	Uab	0.1V	0-65535	ab line voltage
2	Ubc	0.1V	0-65535	bc line voltage
3	Uca	0.1V	0-65535	ca line voltage
4	Ia	0.1A	0-65536	a phase current
5	Ib	0.1A	0-65535	b phase current
6	Ic	0.1A	0-65535	c phase current
7	Upv1	0.1V	0-65535	PV1 voltage
8	Ipv1	0.1A	0-65535	PV1 electric current
9	Upv2	0.1V	0-65535	PV2 voltage
10	Ipv2	0.1A	0-65535	PV2 electric current
11	Upv3	0.1V	0-65535	PV3 voltage
12	Ipv3	0.1A	0-65535	PV3 electric current
13	Fgrid	0.1HZ	0-65535	grid frequency
14	ModuleT	0.1℃	0-65535	module temperature
15	CassT	0.1℃	0-65535	inverter housing temperature

<b>16</b>	EnergyToday_H	WH	0-65535	day generation
<b>17</b>	EnergyToday_L		0-65535	
<b>18</b>	PowerCurrent_H	W	0-65535	current generation power
<b>19</b>	PowerCurrent_L		0-65535	
<b>20</b>	RunTime_H	second	0-65535	the cumulative generation time of the day
<b>21</b>	RunTime_L		0-65535	
<b>22</b>	EnergySum_H	WH	0-65535	current cumulative power generation
<b>23</b>	EnergySum_L		0-65535	
<b>24</b>	E01		0-65535	Bit0: IntFaultE Bit1: IntFaultD Bit2: IntFaultC Bit3: IntFaultB Bit4: IntFaultA Bit5: IntFaultN Bit6-7: reserved Bit8: IntFaultM Bit9: IntFaultL Bit10: IntFaultK Bit11: IntFaultJ Bit12-13: reserved Bit14: IntFaultG Bit15: reserved
<b>25</b>	E02		0-65535	Bit0-7: reserved Bit8: IntProtectT Bit9: IntProtectU Bit10-Bit15: reserved
<b>26</b>	E03		0-65536	Bit0: IntProtectN Bit1: GridV.OutLim Bit2: EmergencyStp Bit3: IntProtectM Bit4: IntProtectL Bit5: AC.ConErr Bit6: IntProtectK Bit7: IntProtectJ Bit8: IntProtectS Bit9: IntProtectR Bit10: IntProtectQ Bit11: IsolationErr Bit12: GFCI.Err Bit13: IntpProtectP Bit14: PV.Reverse Bit15: IntProtectO

<b>27</b>	E04		0-65535	Bit0: GridV.OutLim Bit1: IntProtectC Bit2: GridF.OutLim Bit3: GridF.OutLim Bit4: GridV.OutLim Bit5: IntProtectB Bit6: TempOver Bit7: IntProtectA Bit8: IntProtectI Bit9: IntProtectH Bit10: IntProtectG Bit11: IntProtectF Bit12: IntProtectE Bit13: PVVoltOver Bit14: IntProtectD
<b>28</b>	E05		0-65535	Bit0-7: reserved Bit8: ExtFanErr Bit9: IntFanErr Bit10: SPICommErr Bit11: EepromErr Bit12: PVBrkerOpen Bit13: TempSensorErr Bit14-15: reserved

## 2) Hold register

Hold register is to store the system configuration parameters of Afore inverter which is readable and writable. The function code of reading hold register is 0x03, writing single register is 0x06

Table 7 Hold register map

Hold Addr	Item	Unit	Range and default	Note
<b>0</b>	DSP Version		0-65535	Dsp version:2.01 Example:0x00C9
<b>1</b>	HMI Version		0-65535	Hmi version:1.01 Example:0x0065
<b>2</b>	Serial Number			Sn[0],[1]
				Sn[2],[3]
<b>3</b>	Serial Number			Sn[4], [5]
				Sn[6] ,[7]
<b>4</b>	Serial Number			Sn[8] ,[9]
				Sn[10], [11]

<b>5</b>	Serial Number			Sn[12] ,[13]
				Sn[14] the last number reserved
<b>6</b>	Safty		0-65535	<b>Exception</b>
<b>7</b>	Time_Year		1-12	Month
	Time_Month		17-255	Year 17 mean 2017
<b>8</b>	Time_Day		0-23	Hour
	Time_Hour		1-31	Day
<b>9</b>	Time_Minute		0-59	Second
	Time_Second		0-59	Minute
<b>10</b>	Com Addr		1-32	Communication address(modbus)
<b>11</b>	Language		0-1	0:English 1:Chiense
<b>12</b>	GridVoltConnLow	0.1V	Accordi ng To grid regulati ons	Lower limit of grid voltage for connecting
<b>13</b>	GridVoltConnHigh	0.1V		Higher limit of grid voltage for connecting
<b>14</b>	GridFreqConnLow	0.01Hz		Lower limit of grid frequency for connecting
<b>15</b>	GridFreqConnHigh	0.01Hz		Higher limit of grid frequency for connecting

### 3) writing single register

<b>1</b>	Safty		0-65535	<b>Exception</b>
<b>2</b>	Time_Year		17-255	Month
	Time_Month		1-12	Year 17 mean 2017
<b>3</b>	Time_Day		1-31	Hour
	Time_Hour		0-23	Day
<b>4</b>	Time_Minute		0-59	Minute
	Time_Second		0-59	Second
<b>5</b>	Com Addr		1-32	Communication address(modbus)
<b>6</b>	Language		0-1	0:English 1:Chiense
<b>7</b>	GridVoltConnLow	0.1V	Accordi ng To grid regulati ons	Lower limit of grid voltage for connecting
<b>8</b>	GridVoltConnHigh	0.1V		Higher limit of grid voltage for connecting
<b>9</b>	GridFreqConnLow	0.01Hz		Lower limit of grid frequency for connecting
<b>10</b>	GridFreqConnHigh	0.01Hz		Higher limit of grid frequency for connecting

Table 8 Grid Regulation

value	Regulation
0x00	China
0x01	UK-G83
0x02	UK-G59
0x03	Australia
0x04	CEI-021
0x05	VDE-0126
0x06	VDE-4105
0x07	ThailandME
0x08	ThailandPE
0x09	Holland
0x0A	France
0x0B	Fra-IL50Hz
0x0C	Fra-IL60Hz
0x0D	Spain
0x0E	Greece-Mai
0x0F	Portugal
0x10	Belgium
0x11	DE-BDEW
0x12	Denmark
0x13	Greece-Isi
0x14	Czech
0x15	Slovak
0x16	Sweden
0x17	Bulgaria
0x18	Brazil
0x19	Holland16A
0x1A	SouthAfric
0x1B	DenMark16A
0x1C	Israel
0x1D	Austria
0x1D	Malaysia
0x1F	Mauritius
0x20	Mexico
0x21	Romania
0x22	Philippin
0x23	SriLanka
0x24	VFJiaDa
0x25	CONNERRA
0x26	Japan50
0x27	Japan60

0x28	VFJiaJia
0x29	Poland
0x2A	DPRK
0x31	India



