AHF/SVG MODBUS Communication Protocol

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| --- | --- | --- | --- |
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| Auditor |  | Date |  |
| Approver |  | Date |  |

Revise Record

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# Outline

## Protocol Overview

MODBUS is an application layer protocol, is widely used in industrial control, it is the de facto industry standard. This protocol describes the MODBUS communication protocol implemented in AHF family. Communication use response mode, the host sends request, then the slave to execute request and response.

About the MODBUS communication protocol standards are not described in this article, please refer to standard MODBUS RTU communication protocol standards.

## Application Scope

This protocol applies to AHF/ASVG/SVG series product, for DSP module data exchange with monitor and for monitor data exchange with background software.

## Reference Standard

MODBUS RTU communication protocol standards

# Based level communication protocol

Asynchronous serial protocol UART

## Physical interface

Two-wireRS485

## Data transfer rate

Optional between 9600/19200/38400bps，default is 19200bps。

## Character format

The transfer mode is asynchronous mode, half duplex mode; start bit contains 1 bit, Data bit contains 8 bits, stop bit contains 1 bit, No check.

# Data type

## Integer

Integer storage format is 2 bytes， transmit high bytes D15~D8first，and then low bytes D7~D0。

## Float

Floating-point storage format is four bytes，use IEEE32 bit standard Floating-point format（Standard C language format），First transmit high bytes D31~D24，second D23~D16，third D15~D8，last transmit low bytes D7~D0。

# Communication

Communication use Master-Slave mode，monitor for the host，DSP module for the slave；or backstage software for the host，monitor for the slave.

After host sent request, host will wait response within 100ms, if no answer or response error, this communication is considered failed.

# Application layer packet/Frame format definition

## Data Verification

Data verification use 16 bits (2byte) cyclic redundancy check (CRC), all information will be verification. CRCs are so called because the check value is a redundancy and the algorithm is based on cyclic codes. The short check value attached at the end of the massage, first add the low byte and then high byte. Please refer to Appendix II for more information.

## Function Code Supported by device

|  |  |
| --- | --- |
| Function Code | Function Description |
| 02 | Read state information and alarming information of the device  |
| 03、04 | Read analog data, waveform data (curve, spectrum), and information of manufacturer |
| 16 | Set parameter into device |

## Function Code 02

**Request Frame：**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Format | Address | Function Code | State Bit Start Address (High) | State Bit Start Address (Low) | State Quantity(High) | State Quantity(Low) | Check |
| Byte | 1 | 1 | 1 | 1 | 1 | 1 | 2 |

Address Range is 0~247，Broadcast Address is 0xff，default address is 1。

Response Frame：

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Format | Address | Function Code | ByteQuantity | Data | Check |
| Byte | 1 | 1 | 1 | …… | 2 |

Byte Quantity = State Quantity /8 + (State Quantity% 8 == 0 ? 0 : 1)

For example:

Get all 61 State and Alarmanalog data:

 TX: 01 02 00 00 00 3D B9 DB

 RX:01 02 08 00 00 00 00 00 00 00 00 C4 12

## Function Code 03、04

Request Frame：

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Format | Address | Function Code | Register Start Address (High) | Register Start Address (Low) | Register Quantity (High) | Register Quantity (Low) | Check |
| Byte | 1 | 1 | 1 | 1 | 1 | 1 | 2 |

Response Frame：

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Format | Address | Function Code | Byte Quantity | Data | Check |
| Byte | 1 | 1 | 1 | …… | 2 |

Byte Quantity = Register Quantity \* 2

For example：get the first frame data（50 analog data）

Tx：01 04 00 00 00 64 F1 E1

Rx：01 04 C8 xx xxxx… CRCL CRCH

xx is mean feedback data ，CRCL:check code(low), CRCH: check code(high)

## Function Code 16

Request Frame：

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Format | Address | Function Code | Register Start Address (High) | Register Start Address (Low) | Register Quantity (High) | Register Quantity (Low) | Data Quantity | Data | Check |
| Byte | 1 | 1 | 1 | 1 | 1 | 1 | 1 | …… | 2 |

Response Frame：

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Format | Address | Function Code | Register Start Address (High) | Register Start Address (Low) | Register Quantity (High) | Register Quantity (Low) | Check |
| Byte | 1 | 1 | 1 | 1 | 1 | 1 | 2 |

## For example:

 1、Set the operation mode as “Constant Q”

Tx:01 10 20 1c00 02 04 41 40 00 00 7E DF

Rx:01 10 20 1c 00 02 8B CE

 2、Set the Constant reactive as 300(300kvar inductive power output)

Tx:01 10 20 54 00 02 04 43 96 00 00 9B 09

 Rx:01 10 20 54 00 02 0B D8

## Error Code

## Request Frame:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Format | Address | Function Code | Fault Code | Check |
| Byte | 1 | 1 | 1 | 2 |

Error Code= Function Code + 0x80

Fault Code

* 01 Function Code Error
* 02 Address Error
* 03 Data Error
* 04 Device Failure
* 05 Confirm
* 06 Busy

# Command/Response information

## Read state information and alarming information of device

Function Code = 02，State Start Address = 0x0000

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| State Address | Byte | Description | Remark | Data Attribute（S:System M：Module）（AHF/SVG/ASVG：M+S） |
| 0x0000 | 1 | Initialize Flag | 0: no Initialization，1: Initialization | SVG600: S |
| 0x0001 | 1 | Running State | 0 ：Standby，1：Run | SVG600: S |
| 0x0002 | 1 | Reserved |  |  |
| 0x0003 | 1 | Reserved |  |  |
| 0x0004 | 1 | Reserved |  |  |
| 0x0005 | 1 | Reserved |  |  |
| 0x0006 | 1 | Reserved |  |  |
| 0x0007 | 1 | Reserved |  |  |
| 0x0008 | 1 | Reserved |  |  |
| 0x0009 | 1 | Reserved |  |  |
| 0x000A | 1 | Reserved |  |  |
| 0x000B | 1 | Reserved |  |  |
| 0x000C | 1 | Reserved |  |  |
| 0x000D | 1 | Reserved |  |  |
| 0x000E | 1 | Reserved |  |  |
| 0x000F | 1 | Reserved |  |  |
| 0x0010 | 1 | Dry contact output 1 | 0:low level，1:High level | SVG600: S |
| 0x0011 | 1 | Dry contact output2 | 0:low level，1:High level | SVG600: S |
| 0x0012 | 1 | Dry contact output3 | 0:low level，1:High level | SVG600: S |
| 0x0013 | 1 | Dry contact output4 | 0:low level，1:High level | SVG600: S |
| 0x0014 | 1 | Dry contact output5 | 0:low level，1:High level | SVG600: S |
| 0x0015 | 1 | Dry contact output6 | 0:low level，1:High level | SVG600: S |
| 0x0016 | 1 | Dry contact output7 | 0:low level，1:High level | SVG600: S |
| 0x0017 | 1 | Dry contact output8 | 0:low level，1:High level | SVG600: S |
| 0x0018 | 1 | Lightning arrester Failure | 0: normal，1: abnormal |  |
| 0x0019 | 1 | Reserved |  |  |
| 0x001A | 1 | Reserved |  |  |
| 0x001B | 1 | Reserved |  |  |
| 0x001C | 1 | Reserved |  |  |
| 0x001D | 1 | Reserved |  |  |
| 0x001E | 1 | Reserved |  |  |
| 0x001F | 1 | Reserved |  |  |
| 0x0020 | 1 | Reserved |  |  |
| 0x0021 | 1 | Reserved |  |  |
| 0x0022 | 1 | Reserved |  |  |
| 0x0023 | 1 | Reserved |  |  |
| 0x0024 | 1 | Reserved |  |  |
| 0x0025 | 1 | Reserved |  |  |
| 0x0026 | 1 | Reserved |  |  |
| 0x0027 | 1 | Reserved |  |  |
| 0x0028 | 1 | Inverter Short-circuit failure | 0: normal，1: abnormal | SVG600: M |
| 0x0029 | 1 | Output current abnormal | 0: normal，1: abnormal | SVG600: M |
| 0x002D | 1 | Inverter over-temperature | 0: normal，1: abnormal | SVG600: M |
| 0x002E | 1 | CT ratio setting failure | 0: normal，1: abnormal | SVG600: S |
| 0x002F | 1 | Inverter overload failure | 0: normal，1: abnormal | SVG600: S |
| 0x0031 | 1 | Input frequency abnormal | 0: normal，1: abnormal | SVG600: S |
| 0x0032 | 1 | Input voltage abnormal | 0: normal，1: abnormal | SVG600: S |
| 0x0036 | 1 | Monitoring parameter setting failure | 0: normal，1: abnormal | SVG600: S |
| 0x0038 | 1 | Emergency stop | 0: normal，1: abnormal | SVG600: S |
| 0x0039 | 1 | Busbar differential abnormal | 0: normal，1: abnormal | SVG600: M |
| 0x003A | 1 | CT current zero point calibration failure | 0: normal，1: abnormal | SVG600: S |
| 0x003B | 1 | Module communication failure | 0: normal，1: abnormal | SVG600: M |
| 0x003C | 1 | Module software compatibility failure | 0: normal，1: abnormal | SVG600: M |

## Read analog data fromdevice

Function Code = 03、04，Register Start Address= 0x0000

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Register Address | Byte | Description | Unit | Data Attribute（S: System M：Module）（AHF/SVG/ASVG：M+S） |
| 0x0000 | 4 | L1 Load Current | A | SVG600：S |
| 0x0002 | 4 | L2 Load Current | A | SVG600：S |
| 0x0004 | 4 | L3 Load Current | A | SVG600：S |
| 0x0006 | 4 | L1 Load THDI | % | SVG600：S |
| 0x0008 | 4 | L2 Load THDI | % | SVG600：S |
| 0x000A | 4 | L3 Load THDI | % | SVG600：S |
| 0x000C | 4 | L1 Load Power Factor |  | SVG600：S |
| 0x000E | 4 | L2 Load Power Factor |  | SVG600：S |
| 0x0010 | 4 | L3 Load Power Factor |  | SVG600：S |
| 0x0012 | 4 | L1 Inductor Current | A | SVG600：M |
| 0x0014 | 4 | L2 Inductor Current | A | SVG600：M |
| 0x0016 | 4 | L3 Inductor Current | A | SVG600：M |
| 0x0018 | 4 | L1 Grid Apparent Power | kVA | SVG600：S |
| 0x001A | 4 | L2 Grid Apparent Power | kVA | SVG600：S |
| 0x001C | 4 | L3 Grid Apparent Power | kVA | SVG600：S |
| 0x001E | 4 | L1 Active Power | kW | SVG600：S |
| 0x0020 | 4 | L2 Active Power | kW | SVG600：S |
| 0x0022 | 4 | L3 Active Power | kW | SVG600：S |
| 0x0024 | 4 | N Line Grid Current | A | SVG600：S |
| 0x0026 | 4 | N Line Load Current | A | SVG600：S |
| 0x0028 | 4 | L1 Grid Current | A | SVG600：S |
| 0x002A | 4 | L2 Grid Current | A | SVG600：S |
| 0x002C | 4 | L3 Grid Current | A | SVG600：S |
| 0x002E | 4 | L1 Grid THDI | % | SVG600：S |
| 0x0030 | 4 | L2 Grid THDI | % | SVG600：S |
| 0x0032 | 4 | L3 Grid THDI | % | SVG600：S |
| 0x0034 | 4 | L1 Grid Power Factor |  | SVG600：S |
| 0x0036 | 4 | L2 Grid Power Factor |  | SVG600：S |
| 0x0038 | 4 | L3 Grid Power Factor |  | SVG600：S |
| 0x003A | 4 | Temperature1 | ℃ | SVG600：M |
| 0x003C | 4 | Temperature2 | ℃ | SVG600：M |
| 0x003E | 4 | Temperature3 | ℃ | SVG600：M |
| 0x0040 | 4 | L1 Grid Reactive Power | kVar | SVG600：S |
| 0x0042 | 4 | L2 Grid Reactive Power | kVar | SVG600：S |
| 0x0044 | 4 | L3 Grid Reactive Power | kVar | SVG600：S |
| 0x0046 | 4 | L1 Grid COSPHI |  | SVG600：S |
| 0x0048 | 4 | L2 Grid COSPHI |  | SVG600：S |
| 0x004A | 4 | L3 Grid COSPHI |  | SVG600：S |
| 0x004C | 4 | L1 Load Reactive Power | kVar | SVG600：S |
| 0x004E | 4 | L2 Load Reactive Power | kVar | SVG600：S |
| 0x0050 | 4 | L3 Load Reactive Power | kVar | SVG600：S |
| 0x0052 | 4 | L1 Comp Current | A | SVG600：S |
| 0x0054 | 4 | L2 Comp Current | A | SVG600：S |
| 0x0056 | 4 | L3 Comp Current | A | SVG600：S |
| 0x0058 | 4 | L1 Comp Current Load Rate | % | SVG600：S |
| 0x005A | 4 | L2 Comp Current Load Rate | % | SVG600：S |
| 0x005C | 4 | L3 Comp Current Load Rate | % | SVG600：S |
| 0x005E | 4 | Temperature 4 | ℃ | SVG600：M |
| 0x0060 | 4 | Temperature5 | ℃ | SVG600：M |
| 0x0062 | 4 | Temperature6 | ℃ | SVG600：M |
| 0x0064 | 4 | L1 Load Apparent Power | kVA | SVG600：S |
| 0x0066 | 4 | L2 Load Apparent Power | kVA | SVG600：S |
| 0x0068 | 4 | L3 Load Apparent Power | kVA | SVG600：S |
| 0x006A | 4 | L1 Load Active Power | kW | SVG600：S |
| 0x006C | 4 | L2 Load Active Power | kW | SVG600：S |
| 0x006E | 4 | L3 Load Active Power | kW | SVG600：S |
| 0x0070 | 4 | L1 Load COSPHI |  | SVG600：S |
| 0x0072 | 4 | L2 Load COSPHI |  | SVG600：S |
| 0x0074 | 4 | L3 Load COSPHI |  | SVG600：S |
| 0x0076 | 4 | L1 Grid Voltage | V | SVG600：S |
| 0x0078 | 4 | L2 Grid Voltage | V | SVG600：S |
| 0x007A | 4 | L3 Grid Voltage | V | SVG600：S |
| 0x007C | 4 | L1 Grid Frequency | Hz | SVG600：S |
| 0x007E | 4 | L2 Grid Frequency | Hz | SVG600：S |
| 0x0080 | 4 | L3 Grid Frequency | Hz | SVG600：S |
| 0x0082 | 4 | L1 Grid THDU | % | SVG600：S |
| 0x0084 | 4 | L2 Grid THDU | % | SVG600：S |
| 0x0086 | 4 | L3 Grid THDU | % | SVG600：S |
| 0x0088 | 4 | Config Variable 1 |  | SVG600：S |
| 0x008A | 4 | Config Variable2 |  | SVG600：S |
| 0x008C | 4 | Config Variable3 |  | SVG600：S |
| 0x008E | 4 | Config Variable4 |  | SVG600：M |
| 0x0090 | 4 | Config Variable5 |  | SVG600：M |
| 0x0092 | 4 | Config Variable6 |  | SVG600：M |
| 0x0094 | 4 | Operation Time | Sec | SVG600：S |
| 0x0096 | 4 | Over 50% Load Operation Time | Sec | SVG600：S |
| 0x0098 | 4 | Below 50%Load Operation Time | Sec | SVG600：S |
| 0x009A | 4 | Positive DC Bus Voltage | V | SVG600：M |
| 0x009C | 4 | Negative DC Bus Voltage | V | SVG600：M |
| 0x009E | 4 | Inductor Temperature | ℃ | SVG600：M |

## Read waveform data（Curve）

Function Code = 03、04，Register Start Address = 0x0500

A complete curve is composed of two sets of data, a total of 128 points, with the valueof one point represented by one byte. Data is transmitted from low to high; the first byte represents the first point, and so on.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Register Address | Byte | Description | Remark | Data Attribute（S:System M：Module）（AHF/SVG/ASVG：M+S）（SVG 600：S） |
| 0x0500 | 128 | L1 Voltage Curve |  |  |
| 0x0540 | 128 | L2 Voltage Curve |  |  |
| 0x0580 | 128 | L3 Voltage Curve |  |  |
| 0x05C0 | 128 | L1 Load Current Curve |  |  |
| 0x0600 | 128 | L2 Load Current Curve |  |  |
| 0x0640 | 128 | L3 Load Current Curve |  |  |
| 0x0680 | 128 | L1 Comp Current Curve |  |  |
| 0x06C0 | 128 | L2 Comp Current Curve |  |  |
| 0x0700 | 128 | L3 Comp Current Curve |  |  |
| 0x0740 | 128 | L1 Grid Current Curve |  |  |
| 0x0780 | 128 | L2 Grid Current Curve |  |  |
| 0x07C0 | 128 | L3 Grid Current Curve |  |  |

## Read waveform Data（Spectrum）

Function Code = 03、04，Register Start Address = 0x0B00

A complete spectrum is composed of 60 points, with each point represented by one byte of data.Data transmission in accordance with the order from low to high and each point only need to transmit once, the first byte represents the first point, and so on.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Register Address | Byte | Description | Remark | Data Attribute（S:System M：Module）（AHF/SVG/ASVG：M+S）（SVG 600：S） |
| 0x0B00 | 80 | L1 THDU Spectrum |  |  |
| 0x0B28 | 80 | L2 THDU Spectrum |  |  |
| 0x0B50 | 80 | L3 THDU Spectrum |  |  |
| 0x0B78 | 80 | L1 Load THDI Spectrum |  |  |
| 0x0BA0 | 80 | L2 Load THDI Spectrum |  |  |
| 0x0BC8 | 80 | L3 Load THDI Spectrum |  |  |
| 0x0BF0 | 80 | L1 Grid THDI Spectrum |  |  |
| 0x0C18 | 80 | L2 Grid THDI Spectrum |  |  |
| 0x0C40 | 80 | L3 Grid THDI Spectrum |  |  |

## Read information of manufacturer

Function Code = 03、04，Register Start Address = 0x1000

|  |  |  |  |
| --- | --- | --- | --- |
| Register Address | Byte | Description | Remark |
| 0x1000 | 2 | Protocol Version  | Decimal representation，such as 100，means V100 protocol. |
| 0x1001 | 2 | Software Version | Decimal representation，upper 12bits represent main version, lower 4 bits represent branch version. Ex: 0x0641，represent main version is 100，and branch version is 01 |
| 0x1002 | 2 | Device Address | 1～247 |
| 0x1003 | 2 | Reserved |  |

## Read information of Monitor Manufacturer

Function Code 03、04，Register Start Address = 0x1200

|  |  |  |  |
| --- | --- | --- | --- |
| Register Address | Byte | Name | Remark |
| 0x1200 | 2 | Protocol Version | Decimal representation，such as 100，means V100 protocol. |
| 0x1201 | 2 | Software Version | Decimal representation，upper 12bits represent main version, lower 4 bits represent branch version. Ex: 0x0641，represent main version is 100，and branch version is 01 |
| 0x1202 | 2 | Device Address | 1～247 |
| 0x1203 | 2 | Reserved | Decimal representation，0：APF，1：SVG，2：ASVG 3：SVG600 |
| 0x1204 | 2 | Dry contact input | From low to high，means dry contact input 1, dry contact input 2 and so on.1：High level0：Low level |
| 0x1205 | 2 | Dry contact output | From low to high，means dry contact output 1, dry contact output 2 and so on.1：High level0：Low level |

## Read Parameter of Device（General settings）

**All the settings are set for all the modules in same time ,IncludeAHF/SVG/ASVG/SVG600;**

Function Code = 03、04，Register Start Address = 0x2000

|  |  |  |  |
| --- | --- | --- | --- |
| Register Address | Byte | Description | Remark |
| Initialization |
| 0x2000 | 4 | Number of Slave | [1-10]，Default 1 |
| 0x2002 | 4 | CT ratio | [0,30000]，Default 300（After setting, module restart） |
| 0x2004 | 4 | External transformer ratio | [0.1,63]，Default1.0（After setting, module restart） |
| 0x2006 | 4 | Parallel Machine Capacity | [10,30000]，Default25（After setting, module restart） |
| 0x200C | 4 | Harmonic Compensation Rate | [0.01.1]，Default1 |
| 0x200E | 4 | Target Power Factor | [-1,1]，Default1 |
| 0x2010 | 4 | Debugging variable address1 | [0,114688]，Default0 |
| 0x2012 | 4 | Debugging variable address2 | [0, 114688]，Default0 |
| 0x2014 | 4 | Debugging variable address3 | [0, 114688]，Default0 |
| 0x2016 | 4 | Debugging variable address4 | [0, 114688]，Default0 |
| 0x2018 | 4 | Debugging variable address5 | [0, 114688]，Default0 |
| 0x201A | 4 | Debugging variable address6 | [0, 114688]，Default0 |
| 0x201C | 4 | Working Mode | For details, see appendix，Default0（Harmonic Compensation） |
| 0x201E | 4 | Starting method | 0:Auto Start Mode1: Manual StartModeDefault1 |
| 0x2020 | 4 | Harmonic CompensationMode | 0= Intelligent,1= successive,2=All，Default1（After setting, module restart） |
| 0x2022 | 4 | CT location | 0:Grid, 1:Load，Default1 （After setting, module restart） |
| 0x2024 | 4 | Reserved |  |
| 0x2026 | 4 | External passive filters setting | Default is 11，optional 0、5、7、11、13 |
| 0x2028 | 4 | CT Wiring  | 0:Series，1：Parallel。Default0 （After setting, module restart） |
| 0x202A | 4 | Reserved |  |
| 0x202C | 4 | Inductor Current Calibration Process | 0:Capacitive Current Calibration，1: Inductive Current Calibration. Default0.（After setting, module restart） |
| 0x202E | 4 | Input frequency | 0:50Hz 1:60Hz Default50Hz |
| 0x2030 | 4 | Reserved |  |
| 0x2032 | 4 | Input Current Abnormal Alarming  | 1:On 0: Off。Default1 |
| 0x2034 | 4 | DYN11/DYN12/YYNSetting | 0:YYN, 1: Dyn11, 2: dyn12。Default0 |
| 0x2036 | 4 | Temperature Derating | 1：On，0：Off。Default1 |
| 0x2038 | 4 | Capacitive Reactive Power Compensation | 1：On，0：Off，Default1 |
| 0x203A | 4 | Reserved |  |
| 0x2046 | 4 |  Target voltage | [100, 700],Default 230V |
| 0x2054 | 4 | Constant reactive | (-3000.0,3000.0),Default is1,Accuracy 0.1 |
| 0x2056 | 4 | VolUpper Limite (%): | [0, 20%], Default 7% |
| 0x2058 | 4 | VolLower Limite (%): | [-20%,0], Default -10% |

## Read parameter of device（parameter of phase angle offset）

Function Code = 03、04，Register start address = 0x2500

|  |  |  |  |
| --- | --- | --- | --- |
| Register Address | Byte | Name | Remark |
| Initialization |
| 0x2502 | 4 | 3rd Harmonic phase angle offset | [-180, 180]，Accuracy 0.1，Default 0 |

## Read parameter of device（Harmonic compensation parameters）

Function Code = 03、04，Register start address = 0x2A00

|  |  |  |  |
| --- | --- | --- | --- |
| Register Address | Byte | Name | Remark |
| Initialization |
| 0x2A00 | 4 | 2ndHarmonic compensation degree  | [0,110]，Default0 |
| 0x2A02 | 4 | 3rdHarmonic compensation degree | [0,110]，Default0 |
| 0x2A04 | 4 | 4thHarmonic compensation degree | [0,110]，Default0 |
| 0x2A06 | 4 | 5th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A08 | 4 | 6th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A0A | 4 | 7th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A0C | 4 | 8th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A0E | 4 | 9th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A10 | 4 | 10th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A12 | 4 | 11th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A14 | 4 | 12th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A16 | 4 | 13th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A18 | 4 | 14th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A1A | 4 | 15th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A1C | 4 | 16th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A1E | 4 | 17th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A20 | 4 | 18th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A22 | 4 | 19th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A24 | 4 | 20th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A26 | 4 | 21th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A28 | 4 | 22th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A2A | 4 | 23th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A2C | 4 | 24th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A2E | 4 | 25th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A30 | 4 | 26th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A32 | 4 | 27th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A34 | 4 | 28th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A36 | 4 | 29th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A38 | 4 | 30th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A3A | 4 | 31th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A3C | 4 | 32th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A3E | 4 | 33th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A40 | 4 | 34th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A42 | 4 | 35th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A44 | 4 | 36th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A46 | 4 | 37th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A48 | 4 | 38th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A4A | 4 | 39th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A4C | 4 | 40th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A4E | 4 | 41th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A50 | 4 | 42th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A52 | 4 | 43th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A54 | 4 | 44th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A56 | 4 | 45th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A58 | 4 | 46th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A5A | 4 | 47th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A5C | 4 | 48th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A5E | 4 | 49th Harmonic compensation degree | [0,110]，Default0 |
| 0x2A60 | 4 | 50th Harmonic compensation degree | [0,110]，Default0 |

## Read parameter of device（No initialization）

Function Code = 03、04，Register start address = 0x2C00end address0x30ff

|  |  |  |  |
| --- | --- | --- | --- |
| Register address | Byte | Name | Remark |
| No initialization |
| 0x2C1A | 4 | Alarming clear | Pass 1 |
| 0x2C1E | 4 | On | Pass 1 |
| 0x2C20 | 4 | Off | Pass 1 |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Setting parameter of device

The parameter value is a floating point, with the value of one floating point represented by 4 bytes. Use function code 16 to set single parameter or multi-parameter; include General parameter, Phase angle offset parameter and Harmonic compensation parameter. Do not need to initialization parameter.

## Read fault record

 Function Code：03、04，Register start address = 0xf000

# Appendix

## Appendix I：Working Mode

Difference Device has deference Working mode：

H：Harmonic compensation Q：Reactive power compensation B：Load balancing

|  |  |
| --- | --- |
| Device | Working Mode |
| AHF | 0:H 1:H+Q 2:H+Q+B 3：Auto-ageing 4：H+B+Q 5：H+B 6: Q+H 7: Q+H+B 8: Q+B+H 9: B+H 10: B+H+Q 11: B+Q+H |
| SVG | 1:Q 2:Q+B 3：Auto- Ageing 4：B+Q 5：B 12：Constant Q |
| ASVG | 3：Auto -Ageing 6: Q+H 8: Q+B+H 9: B+H 11: B+Q+H |

## Appendix II: CRC calculate function

Pass parameter：buffer:Array pointer

 Length:Data length

Return Value：16 bit CRC

|  |
| --- |
| unsigned short calculateCRC16(const unsigned char \* buffer, int length){ unsigned short InitCrc = 0xffff; unsigned short Crc = 0; inti = 0; int j = 0; if ((buffer == 0) || (length <= 0)) { return 0; } for(i=0; i<length; i++) { InitCrc ^= buffer[i]; for(j=0; j<8; j++) { Crc = InitCrc; InitCrc>>= 1; if(Crc&0x0001) InitCrc ^= 0xa001; } } return InitCrc;｝ |

## Appendix III：DSP module communication and explanation

* Analog，each frame is not more than 50, the last one if less than 50, take the actual number of remaining.
* Parameter setting support single parameter setting and multiple parameter setting. For the multiple parameter setting, the start address must be fixed and each frame is not more than 60. By classification general parameters, phase angle offset parameter, harmonic compensation parameters, and no initialization parameters.The last one if less than 60, take the actual number of remaining.
* Histogram data, read three phases by one time.
* Module communication band rate is fixed at 19200bps.