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# AEM96 Three-phase Electricity Meter

User’s Manual (V2.1)

Acrel Co., Ltd.

# Declaration

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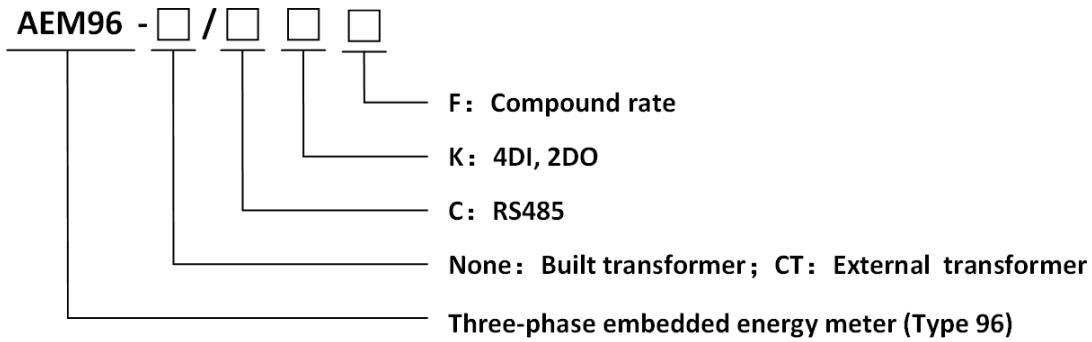
# Contents

# 1 Overview

AEM three-phase embedded multi-function electricity meter is a smart meter designed for power supply system, industrial and mining enterprises and utilities to calculate the electricity consumption and manage the electric demand. It features the high precision, small size and simple installation. It integrates the measurement of all electrical parameters with the comprehensive electricity metering and management provides various data on previous 24 hours, previous 31 days and previous 12 months, checks the 63st harmonic content and the total harmonic content, realizes the remote communication and the remote control with switching input and relay output and boasts the alarm output. It is fitted with RS485 communication port and adapted to MODBUS-RTU or DL/T645-2007 protocol. AEM electricity meter can be used in all kinds of control systems, SCADA systems and energy management systems.

# 2 List of functions

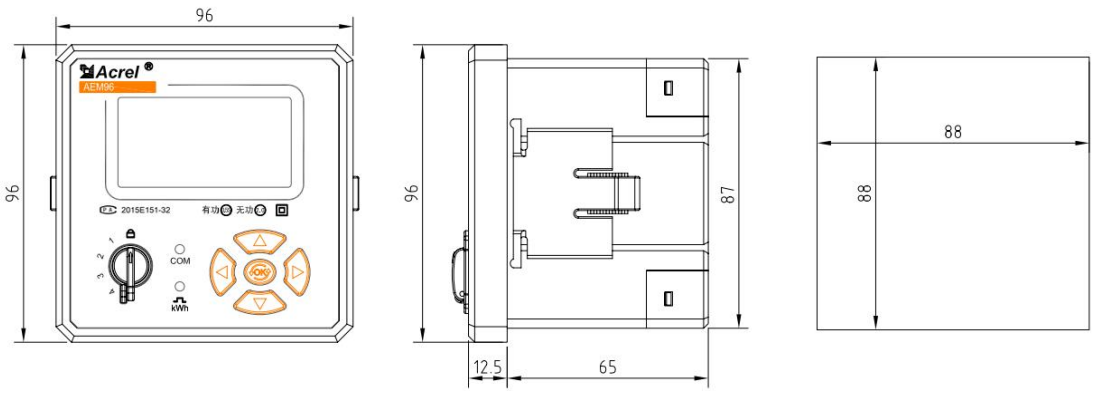



| Model | Basic functions | Form | Remark |
|---|---|---|---|
| AEM96 | Measurement of all electric parameters in three phases, four-quadrant electricity metering, multi-rate tariff, peak demand, historical data on electricity consumption, Switching input incident record , historical extremes records ,analysis of 63st harmonic content and total harmonic content, A,B,C Three phase and Fundamental parameter( Voltage ,current ,power ). switching value, alarm output, RS485 (MODBUS or DL/T645-2007 protocol) | 96 | 1. Historical data on electricity consumption: data on electricity consumption covering previous 12 hours, previous 63 days and previous 12 months<br>2. Multi-rate tariff: maximum 4 time zones, 4 time schedules, 12 day time periods, 4 tariff rates<br>3. 2DO4DI |

# 3 Technical parameters

| Item | | | Performance parameters |
|---|---|---|---|
| Specification | | | 3-phase 3-wire, 3-phase 4-wire |
| Measurement | Voltage | Reference voltage, Un | AC220V、AC100V、AC57.7V |
| | | Measuring range | 0.7Un~1.3Un |
| | | Limit voltage | 1.9Un |
| | | Power dissipation | <0.05VA (single phase) |
| | | Impedance | >2MΩ |
| | | Accuracy class | RMS, accuracy: 0.2 % |
| | Current | Measuring range | 1.5(6)A |
| | | Power dissipation | <0.05VA (single-circuit rated current) |
| | | Accuracy class | RMS, accuracy: 0.2 % |
| | Frequency | | Active, reactive and apparent power, accuracy: 0.5% |
| | Line frequency | | 45-65Hz, accuracy: 0.2 % |
| | fractional harmonic | | $2^{nd}$-$63^{st}$ harmonic, accuracy: ±5 % |
| Metering | Electric energy | | Active energy ((accuracy class: 0.5S)<br>Reactive energy (accuracy class: 2) |
| | Clock | | ≤0.5s/d |
| Digital signal | Electrical pulse output | | 1-way active optical coupling output, 1-way reactive optical coupling output |
| | Switching output | | 2-way relay output |
| | Switching input | | 4-way optical coupling input, , active +12V |
| Communication | Port and communication protocol | | RS485 port: Modbus RTU protocol |
| | Range of communication address | | Modbus RTU: 0-247 |
| | Baud rate | | Low rate (1200bps-9600bps) or high rate (1200bps-38400bps) |
| Environment | Working temperature | | -25℃-+60℃ |
| | Extreme working temperature | | -35℃-+70℃ |
| | Relative humidity | | ≤95% (without dewing) |
| Working power | | | AC/DC power supply (voltage range: AC85V-265V, DC100-380V)<br>Power dissipation: ≤1W，2VA |

# 4 Overall dimensions (unit: mm)

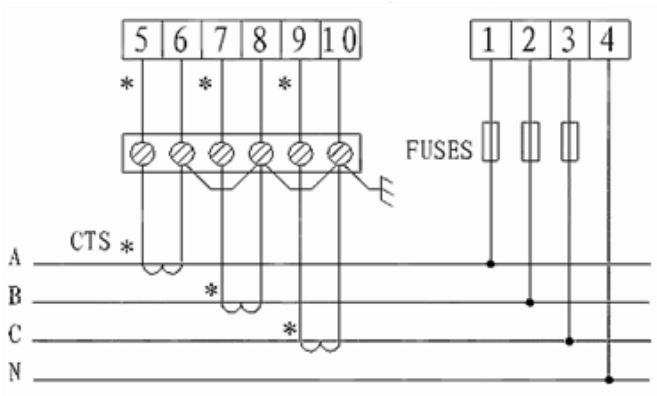



Front View Left View Hole Size

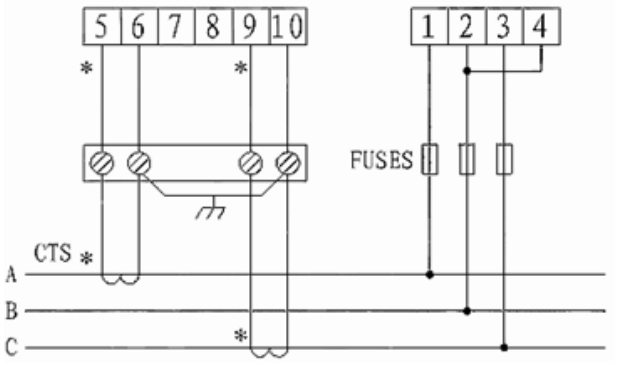
Dimensions of AEM96

# 5 Wiring and installation

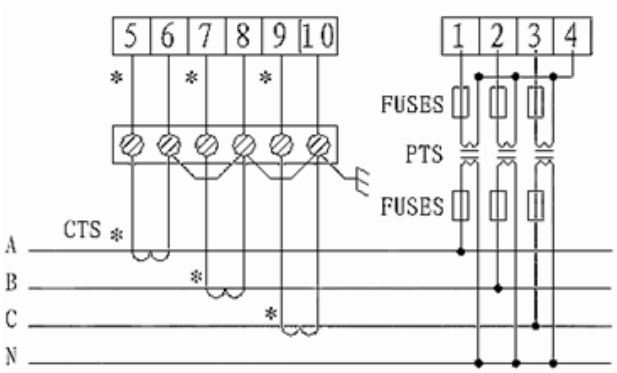
5.1 Voltage and current signal terminals



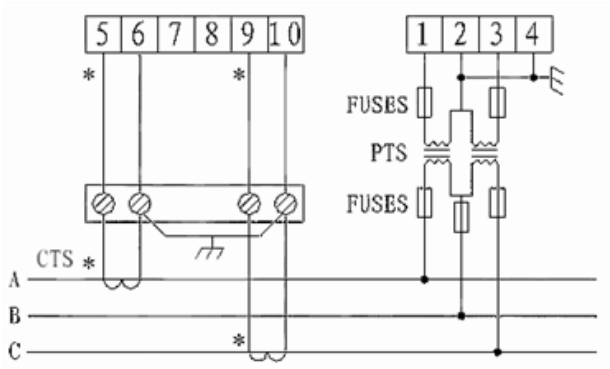

3CT (3-phase 4-wire)




2CT (3-phase 3-wire)

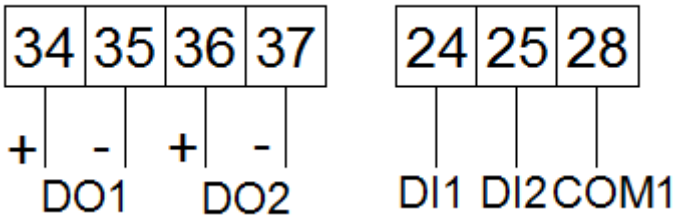



3PT, 3CT (3-phase 4-wire)




2PT, 3CT (3-phase 3-wire)

5.2 Switching input/ output terminals

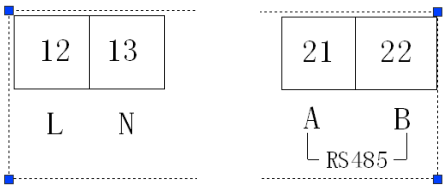



Switching output Switching input

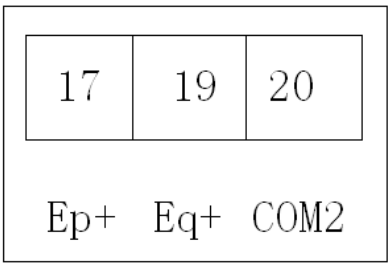
The switching output is realized by relay for remote control and alarm output.

The switching input is realized by switching signal input. The meter has a built-in +12V working power supply so that it does not require external power supply. The meter collects the external break-make information with switching input module and displays it locally. The switching input not only collects and displays the local break-time information but also provides the remote transmission, i.e. remote communication, with RS485.

5.3 Power supply terminal, RS485 communication terminal, pulse output terminal




Auxiliary power supply Communication




Pulse terminals

Note: terminals 17 and 18: active energy pulse terminals; terminals 19 and 20: clock/ reactive energy common pulse terminal, default: clock pulse terminal

# 6 Main function features

6.1 Measurement

Measure all electrical parameters, including voltage U, current I, active power P, reactive power Q, apparent power S, power factor PF, frequency, 63$^{st}$ harmonic content and total harmonic content. The measured voltage U keeps one decimal place, the measured frequency F keeps two decimal places, the measured current I keeps three decimal places and the measured power P keeps four decimal places.

Example: U = 220.1V, f = 49.98HZ, I = 1.999A, P = 0.2199KW

6.2 Metering

Meter the current combined active energy, positive active energy, negative active energy, inductive reactive energy and capacitive reactive energy.

6.3 Tiered pricing

Set four time schedules and 4 time zones of year. A time schedule includes 12 day time periods and 4 rates (F1, F2, F3 and F4: sharp rate, peak rate, flat rate and off rate). The basic idea of tiered pricing structure is to consider the electric energy as a commodity. The electricity price is higher during the sharp and peak periods while it is relatively lower during the off period. By means of economic lever, such pricing structure will balance the electricity consumption between sharp and peak periods and off period, improve the service efficiency of utility and increase the overall economic benefits.

6.4 Demand

Demand-related concepts are listed as follows:

| | |
|---|---|
| Demand | Average power measured during the demand period |
| Max. demand | Maximum amount of demand during a specified period of time |
| Sliding window time | A recurrence method to measure the demand from any time point during a period shorter than the demand period. The demand measured by this means is called sliding demand. The recurrence time is sliding window time. |
| Demand | Time interval when the same average power is measured continuously, also known as |

| | |
|---|---|
| period | window time |

The default demand period is 15 minutes and the default sliding window time is 1 minute.

Both demand period and sliding window time are adjustable. Refer to the details of setting in 7.3.

Measure four maximum demands, i.e. positive active, negative active, inductive reactive and capacitive reactive demands and the time of maximum demand.

6.5 Historical data

Record the historical data on electricity consumption covering previous 24 hours, previous 31 days and previous 12 months (including four quadrant and multi-rate tariff).

6.6 Switching input/ output

There are two-way switching output and four-way switching input. The switching output is realized by relay for remote control and alarm output. The switching input not only collects and displays the local break-time information but also provides the remote transmission, i.e. remote communication, with RS485.

# 7 Operations and display

7.1 Key functions

There are four keys, i.e. four direction keys and one OK in the middle. Operate OK to make a change among eight screens and parameters to be modified on the programming screen. Operate keys Left and Right to change the display of current energy during sharp, peak, flat or off period on screen Energy Display (AEM96) and the display of historical data on energy during previous hour, day or month on screen Historical Data and to move the cursor on screen Programming.

7.2 Screens

There are mainly eight screens. Operate OK to make a change among eight screens. They are Electrical Parameters, Current Energy, Historical Hourly Data, Historical Daily Data, Historical Monthly Data, Maximum Demand, Basic Information and Harmonic Content.

**Electrical Parameters** Make a change among voltage, current, active power, reactive power, apparent power and power factor by keys Up and Down. Except power factor, Make a change among display of all electric parameters Maximum, Minimum and occurrence time by keys

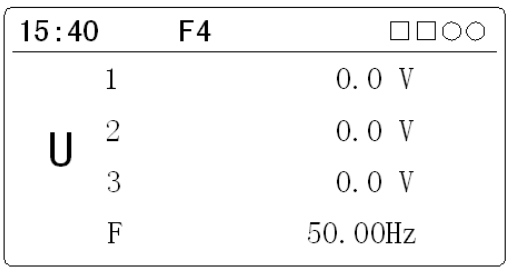


Fig. 1.1 Voltage

**Current Energy** Make change of current combined active energy, positive active, negative active, inductive reactive and capacitive reactive energy by keys Up and Down and change the display of current energy during sharp, peak, flat or off period by keys Left and Right.

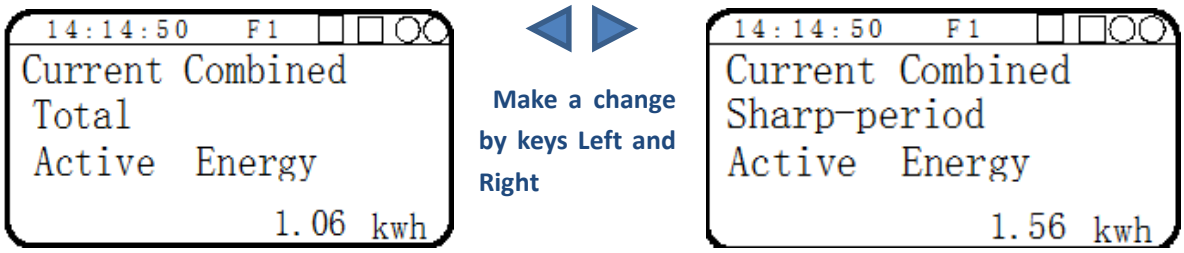



Fig. 1.2 Energy

Total amount of current combined active energy

Peak amount of current active energy

**Historical Data** (hourly, daily and monthly) Make a change in the same way. Operate keys Up and Down to change the time point and keys Left and Right to change the type of historical data. The previous time point is shown in the left lower corner of screen. The meaning of time point varies with the type of historical data.

XX-XX: DD-HH, i.e. day-hour in the hourly data mode

MM-DD, i.e. month-day in the daily data mode

YY-MM, i.e. year-month in the monthly data mode

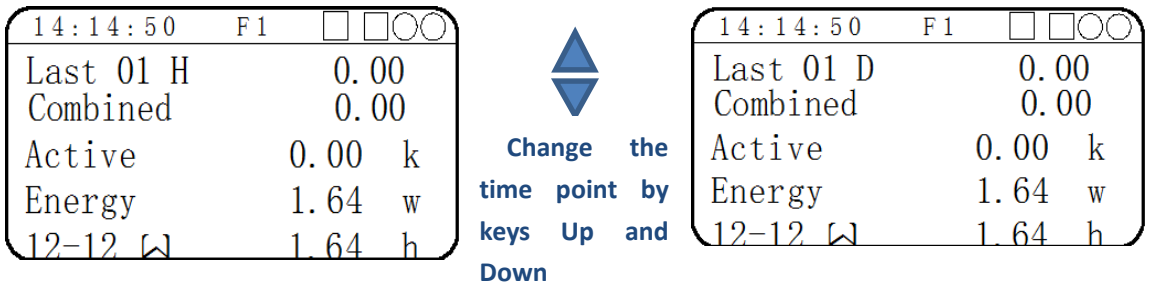



Fig. 1.3 Historical Data

Active energy during the previous hour Sharp Peak Flat Off Total

Active energy during the previous day Sharp Peak Flat Off Total

**Maximum Demand** Operate keys Up and Down to display the maximum positive active demand, negative active demand, inductive reactive demand and capacitive reactive demand in turn.

**Basic Information** Display the communication address, baud rate, protocol, PT, CT,

fault and version number.

**Harmonic Content** Display 63st harmonic content and total harmonic content. Operate keys Left and Right to check the number of current harmonic and keys Up and Down to check the type of current harmonic (Ua, Ub, Uc, Ia, Ib, Ic in turn).

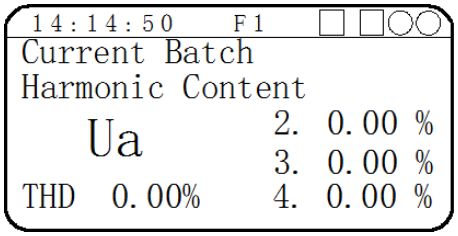



Fig. 1.4 Harmonic Content

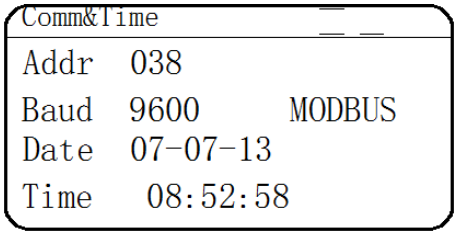
Current harmonic content

7.3 Programming screen and operations

Operate the knob on the left of meter to select a programming screen. Programming screens 1, 2, 3 and 4 are used to set the communication time, system parameters, switching output and 1st time schedule.

To enter a programming screen, input a correct password. If the password is wrong, the corresponding screen will not be accessible and system will wait the user to input a correct password.

1.Set parameters relating to communication and time, such as address and baud rate on this screen. The English screen of Model AEM96 is shown as follows:




(AEM96)

Fig. 1.5 Communication and Time Setting

Address

Baud rate

Address

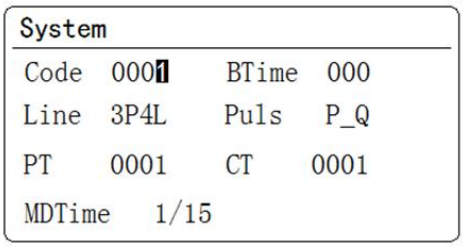
Baud rate

Protocol

Date

Time

2.Set system parameters, such as password, backlight time, line system, demand period, PT and CT on the screen as shown.




(AEM96 )

Fig. 1.6 System Parameter Setting

Code: password

BTime: backlight time. The screen will be always bright if the BTime is set to 0.

Line: selection of line system

Puls: function selection of terminal 19. Terminal 19 outputs the reactive pulse if P_Q is selected. Terminal 19 outputs the time pulse if P_T is selected.

MDTime: demand time and sliding window time. It has four options of demand time, i.e. 15 minutes, 30 minutes, 45 minutes and 60 minutes. The sliding window time is proportional to the demand period. In principle, the ratio of demand time to the sliding window time is 15.

3. Set the type of switching output and alarm on the screen. The switching value can be set to be alarm output, threshold value of alarm output, delay time, pulse width or otherwise. The English screen of Model AEM96 is shown as follows:

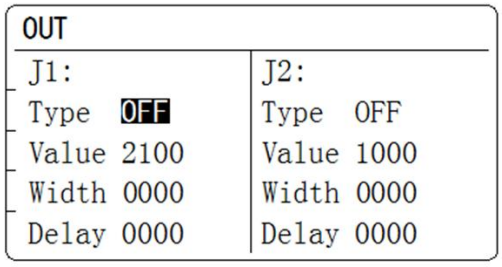



Fig. 1.7 Alarm Setting

Type: type of alarm. Selection of OFF indicates the remote control rather than alarm output. And such selection invalidates other selections on the screen. Besides OFF, user may select the type of alarm <> of U and I. Ux and Ix reflects the alarm output if any voltage or current meets requirements. M1 to M4 four reperesents forward demand for active power、 reversing demand for active power、forward demand for reactive power、 reversing demand for reactive power;

Value: threshold value of alarm. Keep the same decimal places as voltage or current value. If the value is set to 1000 in the type U, for example, it means 100.0v. If the value is set to 1000 in type I, for example, it means 1.000A.

Width: pulse width. An alarm is a level output if the width is set to zero. It is normally closed if requirements are met and normally open if requirements are not met. If the width is set to 60, for example, rather than 0, the relay is closed for 600ms when requirements are met. In other words, the unit is 10ms.

Delay: alarm delay. If it is set to zero, an alarm will be given without delay. If the setting is not zero, an alarm will be given after delay for tx100ms (t: delay setting).

4．Set the first time schedule on the screen. F1, F2, F3 and F4 indicate the sharp, peak, flat and off periods. The following figure illustrates the screen:

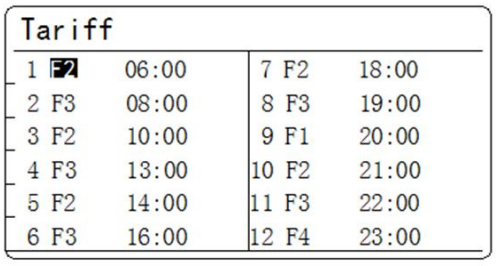



Fig. 1.8 Time Schedule Setting

# 8 Communication instructions

RS485 port of electricity meter supports the MODBUS-RTU communication protocol. The baud rate of communication port can be set to 600bps, 1200bps, 2400bps, 4800bps, 9600bps, 19200bps and 38400bps. The check digit is set to None.

RS485 port is connected with shielded twisted wire. The wiring must consider the network layout, such as the length and route of communication line, position of host computer, network end resistor, communication converter, network expandability, network coverage and environmental electromagnetic interference.

注：

Note:

1.The wiring work must observe applicable requirements strictly.

2.Even though some meters do not require the communication temporarily, it is still necessary to connect them to RS-485 network for troubleshooting and test.

3.Select the double-color twisted wire, wherever possible, for RS-485 connection. For all RS485 ports, the color of wire at side A is same and the color of wire at side B is same too.

4.The maximum length of RS-485 bus (from the communication port of host computer to the end communication port of any connected meter) is 1200m.

## 8.1 Address list

The meter supports command 03H and 10H in the MODBUS-RTU protocol. Command 03H is to read several registers and command 10H is to write several registers. Users are responsible for checking the protocol data format. The following table lists the addresses of meter registers.

| Address | Data | Length | Remark |
|---|---|---|---|
| 0000H | Address | 2 | |
| 0001H | Baud rate | 2 | 1:9600;2:4800;3:2400;4:1200 |
| 0002H | Running control byte | 2 | Note 1 |

| | | | |
|---|---|---|---|
| 0003H | Backlight time | 2 | |
| 0004H | VT | 2 | Unsigned int |
| 0005H | CT | 2 | |
| 0006H | Common pulse selection | 2 | 0: reactive pulse; 1: clock pulse |
| 0007H | Pulse constant | 2 | |
| 0008H | Sliding window time/ demand period | 2 | |
| 0009H | Password | 2 | |
| 000AH～000CH | Date time | 6 | second 、Minute 、 hour 、day、month、Year |
| 000DH～0014H | Time zone | 16 | Odd registers are number of 4 time lists, even registers are date(month on high byte, day on low byte) |
| 0015H～002CH | Time schedule 1(old) | 48 | Odd registers are 12 periods of rate, even registers are time(hour on high byte, minute on low byte) |
| 002DH～0044H | Time schedule 2(old) | 48 | Same as above |
| 7200H～7217H | Time schedule 1(new) | 48 | Even registers are 12 periods of rate, odd registers are time(hour on high byte, minute on low byte) |
| 7218H～722FH | Time schedule 2(new) | 48 | Same as above |
| 7230H～7247H | Time schedule 3(new) | 48 | Same as above |
| 7248H～725FH | Time schedule 4(new) | 48 | Same as above |
| 0045H | J1 control | 2 | Rely 1: 0 disconnect; 1 connect |
| 0046H | J2 control | 2 | Rely 2: 0 disconnect; 1 connect |
| 0047H | Status of switching value | 2 | Note 4 |
| 0048H | J1 output pulse width | 2 | Note 2 |
| 0049H | Type of J1 alarm | | |
| 004AH | Threshold value of J1 alarm | | |
| 004BH | Delay of J1 alarm | | |
| 004CH | J2 output pulse width | | |
| 004DH | Type of J2 alarm | | |
| 004EH | Threshold value of J2 alarm | | |
| 004FH | Delay of J2 alarm | | |
| 0050H | UA | 2 | Unsigned int |
| 0051H | UB | | |
| 0052H | UC | | |
| 0053H | UAB | | |
| 0054H | UBC | | |
| 0055H | UCA | | |

| | | | |
|---|---|---|---|
| 0056H | IA | 2 | Unsigned int |
| 0057H | IB | | |
| 0058H | IC | | |
| 0059H | IN | | |
| 005AH | PA | 2 | 4 decimal places<br>Unsigned int |
| 005BH | PB | | |
| 005CH | PC | | |
| 005DH | PT | | |
| 005EH | QA | | |
| 005FH | QB | | |
| 0060H | QC | | |
| 0061H | QT | | |
| 0062H | SA | | |
| 0063H | SB | | |
| 0064H | SC | | |
| 0065H | ST | | |
| 0066H | PFA | 2 | 3 decimal places, unsigned int |
| 0067H | PFB | | |
| 0068H | PFC | | |
| 0069H | PF | | |
| 006AH | Power direction | 2 | Note 3 |
| 006BH | Frequency | 2 | 2 decimal placles, unsigned int |
| 006CH | Current forward demand for active power | 2 | 4 decimal places, unsigned int |
| 006DH | Current reversing demand for active power | 2 | |
| 006EH | Current forward demand for reactive power | 2 | |
| 006FH | Current reversing demand for reactive power | 2 | |
| 0070H | Maximum forward demand for active power | 2 | |
| 0071H～0072H | Time of occurrence | 4 | Minute 、 hour 、day、 month |
| 0073H | Maximum reversing demand for active power | 2 | |
| 0074H～0075H | Time of occurrence | 4 | Minute 、 hour 、day、 month |
| 0076H | Maximum forward demand for active power | 2 | |
| 0077H～0078H | Time of occurrence | 4 | Minute 、 hour 、day、 month |
| 0079H | Maximum reversing demand for active power | 2 | |
| 007AH～007BH | Time of occurrence | 4 | Minute 、 hour 、day、 month |
| 007CH～007DH | Current combined total active energy | 4 | 2 decimal places, unsigned int |
| 007EH～007FH | Current forward total active energy | 4 | |
| 0080H～0081H | Current reversing total active energy | 4 | |
| 0082H～0083H | Current forward total reactive energy | 4 | |

| | | |
|---|---|---|
| 0084H～0085H | Current reversing reactive energy | 4 |
| 0086H～0087H | Current Sharp-period combined active energy | 4 |
| 0088H～0089H | Current Peak-period combined active energy | 4 |
| 008AH～008BH | Current Flat-period combined active energy | 4 |
| 008CH～008DH | Current valley-period combined active energy | 4 |
| 008EH～008FH | Current forward active energy on Sharp-period | 4 |
| 0090H～0091H | Current forward active energy on Peak-period | 4 |
| 0092H～0093H | Current forward active energy on Flat-period | 4 |
| 0094H～0095H | Current forward active energy on Valley-period | 4 |
| 0096H～0097H | Current reversing active energy on Sharp-period | 4 |
| 0098H～0099H | Current reversing active energy on Peak-period | 4 |
| 009AH～009BH | Current reversing active energy on Flat-period | 4 |
| 009CH～009DH | Current reversing active energy on Valley-period | 4 |
| 009EH～09FH | Current forward reactive energy on Sharp-period | 4 |
| 00A0H～00A1H | Current forward reactive energy on Peak-period | 4 |
| 00A2H～00A3H | Current forward reactive energy on Flat-period | 4 |
| 00A4H～00A5H | Current forward reactive energy on Valley-period | 4 |
| 00A6H～00A7H | Current reversing reactive energy on Sharp-period | 4 |
| 00A8H～00A9H | Current reversing reactive energy on Peak-period | 4 |
| 00AAH～00ABH | Current reversing reactive energy on Flat-period | 4 |
| 00ACH～00ADH | Current reversing reactive energy on valley -period | 4 |

| | | | |
|---|---|---|---|
| 00AEH～00AFH | Total amount of phase A combined active energy | 4 | |
| 00B0H～00B1H | Total amount of phase A positive active energy | 4 | |
| 00B2H～00B3H | Total amount of phase A negative active energy | 4 | |
| 00B4H～00B5H | Total amount of phase A positive reactive energy | 4 | |
| 00B6H～00B7H | Total amount of phase A negative active energy | 4 | |
| 00B8H～00B9H | Total amount of phase B combined active energy | 4 | |
| 00BAH～00BBH | Total amount of phase B positive active energy | 4 | |
| 00BCH～00BDH | Total amount of phase B negative active energy | 4 | |
| 00BEH～00BFH | Total amount of phase B positive reactive energy | 4 | |
| 00C0H～00C1H | Total amount of phase B negative reactive energy | 4 | |
| 00C2H～00C3H | Total amount of phase C combined active energy | 4 | |
| 00C4H～00C5H | Total amount of phase C positive active energy | 4 | |
| 00C6H～00C7H | Total amount of phase C negative active energy | 4 | |
| 00C8H～00C9H | Total amount of phase C positive reactive energy | 4 | |
| 00CAH～00CBH | Total amount of phase C negative reactive energy | 4 | |
| 00CCH | THDUa | 2 | 2 decimal places, unsigned int |
| 00CDH | THDUb | | |
| 00CEH | THDUc | | |
| 00CFH | THDIa | | |
| 00D0H | THDIb | | |
| 00D1H | THDIc | | |
| 00D2H～00EFH | THUa (2nd-31st harmonic) | 2×30 | Each harmonic length is a register. 2 decimal places, unsigned int |
| 00F0H～010DH | THUb (2nd-31st harmonic) | 2×30 | |
| 010EH～012BH | THUc (2nd-31st harmonic) | 2×30 | |
| 012CH～0149H | THIa (2nd-31st harmonic) | 2×30 | |
| 014AH～0167H | THIb (2nd-31st harmonic) | 2×30 | |

| | | | |
|---|---|---|---|
| 0168H～0185H | THIc (2nd-31st harmonic) | 2×30 | |
| 0186H | phase A fundamental voltage | 2 | 1 decimal places, unsigned int |
| 0187H | phase B fundamental voltage | | |
| 0188H | phase C fundamental voltage | | |
| 0189H | phase A harmonic voltage | | |
| 018AH | phase B harmonic voltage | | |
| 018BH | phase C harmonic voltage | | |
| 018CH | phase A fundamental current | 2 | 3 decimal places, unsigned int |
| 018DH | phase B fundamental current | | |
| 018EH | phase C fundamental current | | |
| 018FH | phase A harmonic current | | |
| 0190H | phase B harmonic current | | |
| 0191H | phase C harmonic current | | |
| 0192H | phase A fundamental active power | 2 | 4 decimal places, unsigned int |
| 0193H | phase B fundamental active power | | |
| 0194H | phase C fundamental active power | | |
| 0195H | Total fundamental active power | | |
| 0196H | phase A fundamental reactive power | | |
| 0197H | phase B fundamental reactive power | | |
| 0198H | phase C fundamental reactive power | | |
| 0199H | Total fundamental reactive power | | |
| 019AH | phase A harmonic active power | | |
| 019BH | phase B harmonic active power | | |
| 019CH | phase C harmonic active power | | |
| 019DH | Total harmonic active power | | |
| 019EH | phase A harmonic reactive power | | |
| 019FH | phase B harmonic reactive power | | |
| 01A0H | phase C harmonic reactive power | | |
| 01A1H | Total harmonic reactive power | | |
| 01A2H | Voltage imbalance | 2 | 2 decimal places, unsigned int |
| 01A3H | Current imbalance | | |
| 01A4H | The angle between the A current and the A voltage | 2 | 2 decimal places, unsigned int |
| 01A5H | The angle between the B current and the B voltage | | |
| 01A6H | The angle between the C current and the C voltage | | |
| 01A7H～01A8H | Positive apparent energy | 4 | 2 decimal places, unsigned int |
| 01A9H～01AAH | Apparent electrical energy on the Sharpe cycle | 4 | |

| | | | |
|---|---|---|---|
| 01ABH～01ACH | Peak apparent electrical energy | 4 | |
| 01ADH～01AEH | Normal apparent electrical energy | 4 | |
| 01AFH～01B0H | Apparent electrical energy in the valley period | 4 | |
| 01B1H | The current A-phase current is required in real time | 2 | 3 decimal places, unsigned int |
| 01B2H | The current B-phase current is required in real time | 2 | |
| 01B3H | The current C-phase current is required in real time | 2 | |
| 01B4H | Current apparent power real-time demand | 2 | |
| 01B5H | A phase current maximum demand | 2 | |
| 01B6H～01B7H | Time of occurrence | 4 | Minutes, hours, days, months |
| 01B8H | B phase current maximum demand | 2 | |
| 01B0H～01B1H | Time of occurrence | 4 | Minutes, hours, days, months |
| 01BBH | C phase current maximum demand | 2 | |
| 01BCH～01BDH | Time of occurrence | 4 | Minutes, hours, days, months |
| 01BEH | Apparent power maximum demand | 2 | |
| 01BFH～01C0H | Time of occurrence | 4 | Minutes, hours, days, months |
| 01C1H | Odd-sequence total harmonic number of phase A voltages | 2 | 2 decimal places, unsigned int |
| 01C2H | Odd-sequence total harmonic number of phase B voltages | 2 | |
| 01C3H | Odd-sequence total harmonic number of phase C voltages | 2 | |
| 01C4H | Odd-order total harmonic number of phase A currents | 2 | |
| 01C5H | Odd-order total harmonic number of phase B currents | 2 | |
| 01C6H | Odd-order total harmonic number of phase C currents | 2 | |
| 01C7H | The number of even-order total harmonics of the A-phase voltage | 2 | |
| 01C8H | The number of even-order total harmonics of the B-phase voltage | 2 | |
| 01C9H | The number of even-order total harmonics of the C-phase voltage | 2 | |
| 01CAH | The total number of harmonics of the even sequence of phase A currents | 2 | |
| 01CBH | The total number of harmonics of the even sequence of phase B currents | 2 | |
| 01CCH | The total number of harmonics of the even sequence of phase C currents | 2 | |

| | | | |
|---|---|---|---|
| 01CDH～01CEH | The total amount of reactive electrical energy at present | 4 | 2 decimal places, unsigned int |
| 01CFH～01D0H | Reactive energy in the current first quadrant | 4 | |
| 01D1H～01D2H | Reactive energy in the current second quadrant | 4 | |
| 01D3H～01D4H | Reactive energy in the current third quadrant | 4 | |
| 01D5H～01D6H | Reactive energy in the current fourth quadrant | 4 | |
| 01D7H | The angle of the A voltage | 2 | 2 decimal places, unsigned int |
| 01D8H | The angle between the B voltage and the A voltage | 2 | |
| 01D9H | The angle between the C voltage and the A voltage | 2 | |
| 01DAH | The angle between the A current and the A voltage | 2 | |
| 01DBH | The angle between the B current and the A voltage | 2 | |
| 01DCH | The angle between the C current and the A voltage | 2 | |
| 7000H～703DH | THUa ($2^{nd}$-$63^{rd}$ harmonic) | 2×62 | Each harmonic length is a register. |
| 703EH～707BH | THUb ($2^{nd}$-$63^{rd}$ harmonic) | 2×62 | 2 decimal places, unsigned int |
| 707CH～70B9H | THUc ($2^{nd}$-$63^{rd}$ harmonic) | 2×62 | |
| 70BAH～70F7H | THIa ($2^{nd}$-$63^{rd}$ harmonic) | 2×62 | |
| 70F8H～7135H | THIb ($2^{nd}$-$63^{rd}$ harmonic) | 2×62 | |
| 7136H～7173H | THIc ($2^{nd}$-$63^{rd}$ harmonic) | 2×62 | |
| 7174H | UA crest coefficient | 2 | 3 decimal places, unsigned int |
| 7175H | UB crest coefficient | 2 | |
| 7176H | UC crest coefficient | 2 | |
| 7177H | IA crest coefficient | 2 | |
| 7178H | IB crest coefficient | 2 | |
| 7179H | IC crest coefficient | 2 | |
| 717AH | A-phase telephone harmonic coefficient | 2 | 2 decimal places, unsigned int |
| 717BH | B-phase telephone harmonic coefficient | 2 | |
| 717CH | C-phase telephone harmonic coefficient | 2 | |
| 717DH | The K factor of the A-phase current | 2 | 2 decimal places, unsigned int |
| 717EH | The K factor of the B-phase current | 2 | |
| 717FH | The K factor of the C-phase current | 2 | |

Note 1

| Running control byte | |
|---|---|
| High byte | Low byte |

| Line system | Protocol |
|---|---|

Note 2

| Type of alarm | |
|---|---|
| High byte | Low byte |
| 0: disable the alarm function | 0：>;1: < |
| 1-4：UA、UB、UC、Ux | |
| 5-8：IA、IB、IC、Ix | |
| 9-12：PA、PB、PC、PT | |

| Output pulse width |
|---|
| 0: level output |
| >0: pulse width in 0.1s |
| Delay of alarm |
| 0: no delay |
| >0: delay in 0.01s |

Note 3

| D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
|---|---|---|---|---|---|---|---|
| Qt | Qc | Qb | Qa | Pt | Pa | Pb | Pc |

Each byte represents one power direction. In details, 1 represents the reversing direction and 0 represents the forward direction.

Note 4： (0x47)

| Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 |
|---|---|---|---|---|---|---|---|
| | | | | DI3 | DI2 | DI1 | DI0 |

1 connect 0 disconnect

8.2 Historical data reading

| Starting address of interval (high byte) | Type of historical data |
|---|---|
| 11-28 | Previous 1 hour- previous 24 hours |
| 29-47 | Previous 1 day- previous 31 days |
| 48-53 | Previous 1 month –previous 12 month |

| Offset address of interval (low byte) | Data type |
|---|---|
| 00 | Recording date time |
| 03 | Total amount of historical combined active energy |
| 05 | Total amount of historical forward active energy |
| 07 | Total amount of historical reversing active energy |
| 09 | Total amount of historical forward reactive energy |
| 0B | Total amount of historical reversing reactive energy |
| 0D | Sharp-period amount of historical combined active energy |
| 0F | Peak-period amount of |

| | |
|---|---|
| | historical combined active energy |
| 11 | Flat-period amount of historical combined active energy |
| 13 | Valley-period amount of historical combined active energy |
| 15 | Sharp-period amount of historical forward active energy |
| 17 | Peak-period amount of historical forward active energy |
| 19 | Flat-period amount of historical forward active energy |
| 1B | Valley -period amount of historical forward active energy |
| 1D | Sharp-period amount of historical reversing active energy |
| 1F | Peak-period amount of historical reversing active energy |
| 21 | Flat-period amount of historical reversing active energy |
| 23 | Valley -period amount of historical reversing active energy |
| 25 | Sharp-period amount of historical forward reactive energy |
| 27 | Peak-period amount of historical forward reactive energy |
| 29 | Flat-period amount of historical forward reactive energy |
| 2B | Valley -period amount of |

| | |
|---|---|
| | historical forward reactive energy |
| 2D | Sharp-period amount of historical reversing reactive energy |
| 2F | Peak-period amount of historical reversing reactive energy |
| 31 | Flat-period amount of historical reversing reactive energy |
| 33 | Valley-period amount of historical reversing reactive energy |
| 35 | Total amount of phase A combined active energy |
| 37 | Total amount of phase A forward active energy |
| 39 | Total amount of phase A reversing active energy |
| 3B | Total amount of phase A forward reactive energy |
| 3D | Total amount of phase A reversing reactive energy |
| 3F | Total amount of phase B combined active energy |
| 41 | Total amount of phase B forward active energy |
| 43 | Total amount of phase B reversing active energy |
| 45 | Total amount of phase B forward reactive energy |
| 47 | Total amount of phase B reversing reactive energy |
| 49 | Total amount of phase C combined active energy |
| 4B | Total amount of phase C forward active energy |
| 4D | Total amount of phase C reversing active energy |
| 4F | Total amount of phase C forward reactive energy |

| | |
|---|---|
| 51 | Total amount of phase C reversing reactive energy |

The register address of historical data is divided into two parts, high byte and low byte. Combining bytes in two tables and then getting the register address of historical data. For example, if you want to read the total amount of historical forward reactive energy for the previous 4 hours, the address will be 1409H.

## 8.3 Historical Alarm output reading

| Starting address of interval (high byte) | Type of historical data |
|---|---|
| | Alarm output event log |

| Offset address of interval (low byte) | Data type |
|---|---|
| 00 | Last 1 alarm output record |
| 05 | Last 2 alarm output record |
| 0A | Last 3 alarm output record |
| 0F | Last 4 alarm output record |
| 14 | Last 5 alarm output record |
| 19 | Last 6 alarm output record |
| 1E | Last 7 alarm output record |
| 23 | Last 8 alarm output record |
| 28 | Last 9 alarm output record |
| 2D | Last 10 alarm output record |

| ADDRH ADDRL | event names | Data type | Note |
|---|---|---|---|
| 0300H | The previous alarm output record | Occurrence time (minute, second) | high byte : seconds |
| 0301H | | Occurrence time (hour, day) | high byte : Hours |
| 0302H | | Occurrence time of Month and year | high byte : Month |
| 0303H | | switch status and number | high byte :DO number(0 : DO1, 1 :DO2 )<br>Low byte: switch status(0: off, 1: on) |
| 0304H | | alarm type | high byte : Limit Alarm (0 :over threshold , 1 :below threshold )<br>Low byte: Alarm parameters ( Note 2 ) |

## 8.4 Historical Switching input reading

| Starting address of interval (high byte) | Type of historical data |
|---|---|
| 03 | Switching input incident record |

| Offset address of interval (low byte) | Data type |
|---|---|
| 32 | Last 1 Switching input record |
| 37 | Last 2 Switching input record |
| 3C | Last 3 Switching input record |
| 41 | Last 4 Switching input record |
| 46 | Last 5 Switching input record |
| 4B | Last 6 Switching input record |
| 50 | Last 7 Switching input record |
| 55 | Last 8 Switching input record |
| 5A | Last 9 Switching input record |
| 5F | Last 10 Switching input record |

| ADDRH ADDRL | event names | Data type | Note |
|---|---|---|---|
| 0332H | Last 1 Switching input record | Occurrence time of seconds and minutes | high byte : seconds |
| 0333H | | Occurrence time of Hours and days | high byte : Hours |
| 0334H | | Occurrence time of Month and year | high byte : Month |
| 0335H | | switch status and number | high byte :DO number(0: DI1, 1: DI2, 2: DI3, 3: DI4 )<br>Low byte: switch status(0: off, 1: on) |
| 0336H | | reservation | |

## 8.5 Record of extreme value and occurrence time

Maximum records:

| Starting address of interval (high byte) | Type of historical data |
|---|---|
| 04 | Extremum of the month and Occurrence time |
| 05 | Extremum of last 1 month and Occurrence time |
| 06 | Extremum of last 2 month and Occurrence time |
| 07 | Extremum of last 3 month |

| Offset address of interval (low byte) | Data type |
|---|---|
| 00 | Voltage of A phase maximum value and occurrence time |
| 03 | Voltage of B phase maximum value and occurrence time |
| 06 | Voltage of C phase maximum value and occurrence time |
| 09 | Voltage between A-B maximum value and |

| | |
|---|---|
| | and Occurrence time |

| | |
|---|---|
| | occurrence time |
| 0C | Voltage between A-B maximum value and occurrence time |
| 0F | Voltage between A-B maximum value and occurrence time |
| 12 | Electricity of A phase maximum value and occurrence time |
| 15 | Electricity of B phase maximum value and occurrence time |
| 18 | Electricity of C phase maximum value and occurrence time |
| 1B | Three phase current vector sum maximum value and occurrence time |
| 1E | Active power of A phase maximum value and occurrence time |
| 21 | Active power of B phase maximum value and occurrence time |
| 24 | Active power of C phase maximum value and occurrence time |
| 27 | Total active power maximum value and occurrence time |
| 2A | Reactive power of A phase maximum value and occurrence time |
| 2D | Reactive power of B phase maximum value and occurrence time |
| 30 | Reactive power of C phase maximum value and occurrence time |
| 33 | Total reactive power maximum value and occurrence time |
| 36 | Apparent power of A phase maximum value and occurrence time |
| 39 | Apparent power of B phase maximum value and occurrence time |
| 3C | Apparent power of C phase maximum value and occurrence time |
| 3F | Total apparent power maximum value and occurrence time |

Minimum record:

| Starting address of interval (high byte) | Type of historical data |
|---|---|

| Offset address of interval (low byte) | Data type |
|---|---|

| | |
|---|---|
| 04 | Extremum of the month and Occurrence time |
| 05 | Extremum of last 1 month and Occurrence time |
| 06 | Extremum of last 2 month and Occurrence time |
| 07 | Extremum of last 3 month and Occurrence time |

| | |
|---|---|
| 42 | Voltage of A phase Minimum Value and occurrence time |
| 45 | Voltage of B phase Minimum Value and occurrence time |
| 48 | Voltage of C phase Minimum Value and occurrence time |
| 4B | Voltage between A-B Minimum Value and occurrence time |
| 4E | Voltage between B-C Minimum value and occurrence time |
| 51 | Voltage between C-A Minimum value and occurrence time |
| 54 | Electricity of A phase Minimum value and occurrence time |
| 57 | Electricity of B phase Minimum value and occurrence time |
| 5A | Electricity of C phase Minimum value and occurrence time |
| 5D | Three phase current vector sum Minimum value and occurrence time |
| 60 | Active power of A phase Minimum value and occurrence time |
| 63 | Active power of B phase Minimum value and occurrence time |
| 66 | Active power of C phase Minimum value and occurrence time |
| 69 | Total active power Minimum value and occurrence time |
| 6C | Reactive power of A phase Minimum value and occurrence time |
| 6F | Reactive power of B phase Minimum value and occurrence time |
| 72 | Reactive power of C phase Minimum value and occurrence time |
| 75 | Total reactive power Minimum value and occurrence time |
| 78 | Apparent power of A phase Minimum value and occurrence time |
| 7B | Apparent power of B phase Minimum value and occurrence time |
| 7E | Apparent power of C phase Minimum value and |

| | |
|---|---|
| | occurrence time |
| 81 | Total apparent power Minimum value and occurrence time |

Note：The record of every extreme value and occurrence time is 6 bits, and the data configuration can be refered as below:

| ADDRH ADDRL | event names | Data type | Note |
|---|---|---|---|
| 0400H | Maximum voltage of A phase and occurrence time | The data of Maximum voltage of A phase | data and decimal place refer to address table 8.1 |
| 0401H | | Occurrence time of minutes and hours | high byte : minutes |
| 0402H | | Occurrence time of Days and months | high byte : Days |

8.6 read records from a historical demand

| Starting address of interval (high byte) | Type of historical data |
|---|---|
| 08 | Historical Demand record |

| Offset address of interval (low byte) | Data type |
|---|---|
| 00 | Last 1 month Demand |
| 0C | Last 2 month Demand |
| 18 | Last 3 month Demand |
| 24 | Last 4 month Demand |
| 30 | Last 5 month Demand |
| 3C | Last 6 month Demand |
| 48 | Last 7 month Demand |
| 54 | Last 8 month Demand |
| 60 | Last 9 month Demand |
| 6C | Last 10 month Demand |
| 78 | Last 11 month Demand |
| 84 | Last 12 month Demand |

Note：The length of each event record is 24 bits, and the data configuration can be referred as below:

| ADDRH ADDRL | event names | Data type | Note |
|---|---|---|---|
| 0800H | Last 1 Switching input record | Forward active demand | Demand Data |

| | | | |
|---|---|---|---|
| 0801H | | Occurrence time of seconds and minutes | high byte : minutes |
| 0802H | | Occurrence time of Days and months | high byte : Days |
| 0803H | | reversing active demand | Demand Data |
| 0804H | | Occurrence time of minutes and hours | high byte : minutes |
| 0805H | | Occurrence time of Days and months | high byte : Days |
| 0806H | | forward reactive demand | Demand Data |
| 0807H | | Occurrence time of minutes and hours | high byte : minutes |
| 0808H | | Occurrence time of Days and months | high byte : Days |
| 0809H | | reversing reactive demand | Demand Data |
| 080AH | | Occurrence time of minutes and hours | high byte : minutes |
| 080BH | | Occurrence time of Days and months | high byte : Days |

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