# AMC Series programmable intelligent meters

Installation and Operation Instruction V3.1

ACREL CO.,LTD

# Declaration

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## Contents

# 1. Summary

AMC series programmable intelligent meters,adopting AC sampling technology,can directly or indirectly measure electric voltage and current of single phase or three phase grid. It can be used for local display,and connecting industrial control device to form measuring control system.

This series of meters have RS-485 port,adopt Modbus-RTU protocol. Analog output,alarm output,switching input/output can be selected. Based on different request,by pressing the keys,parameters of ratio,alarm,communication etc. can be modified.

# 2.Type Description

<div align="center">Table 1</div>

| Type | Basic function | Shape | Optional function |
|---|---|---|---|
| AMC48-AI<br>AMC48-AV | Current,voltage measurement;<br>LED | 48 Square | RS485 communication (/C )<br>Analog output (/M ) |
| AMC48-AI3<br>AMC48-AV3 | | | None |
| AMC48L-AI<br>AMC48L-AV | Current,voltage measurement;<br>LCD | | 1.RS485 communication (/C )<br>2.Analog output (/M ) |
| AMC48L-AI3<br>AMC48L-AV3 | | | None |
| AMC72-AI<br>AMC72-AV<br>AMC72-AI3<br>AMC72-AV3 | Current,voltage measurement;<br>LED | 72 Square | 1.RS485 communication (/C )<br>2.Analog output (/M )<br>3.Alarmoutput (/J)<br>4.Analog output + RS485 communication (/MC )<br>5.RS485 communication + switching output 2DI2DO (/KC )<br>6.Alarm output + analog output +RS485 communication (/JMC ) |
| AMC72-DI<br>AMC72-DV | DC voltage,current measurement;<br>LED | | |
| AMC72L-AI<br>AMC72L-AV<br>AMC72L-AI3<br>AMC72L-AV3 | Current,voltage measurement;<br>LCD | | |
| AMC72L-DI<br>AMC72L-DV | DC voltage,current measurement;<br>LCD | | |
| AMC96-AI<br>AMC96-AV<br>AMC96-AI3<br>AMC96-AV3 | Current,voltage measurement;<br>LED | 96 Square | 1.RS485 communication (/C )<br>2.Analog output (/M or /3M )<br>3.Alarm output (/J)<br>4.Analog output + RS485 communication (/ MC or /M3C )<br>5.RS485 communication + switching 4DI2DO (/KC )<br>6.Alarm output+ analog output +RS485 communication (/JMC ) |
| AMC96L-AI<br>AMC96L-AV<br>AMC96L-AI3<br>AMC96L-AV3 | Current,voltagemeasurement;<br>LCD | | |
| **Note:1. AI/AV means single-phase current/voltage,AI3/AV3 means three-phase current/voltage;**<br>**2. /Jmeans 1 channel relay output (multiplexing with second channel switching output)** | | | |

# 3 Technical parameter

<div align="center">Table 2</div>

| Technical parameter | | Value |
|---|---|---|
| Input | Rated value | AC voltage:Single phaseAC 100V,400V<br>　　　　　　　　Three phaseAC 100V,400V,660V(UL-L,Only 72/ 96)<br>AC current:AC1A,5A;<br>DC voltage:1000V,300V,75mV,10V;<br>DC current: 0-20mA,4-20mA,5A; |
| | Overload | Voltage: 1.2 times rated value(continuous); 2 times rated value /1 second<br>Current:1.2 times rated value(continuous); 10 times rated value /1 second |
| | Frequency | 45Hz～65Hz |
| | Power consumption | Power consumption of each voltage,current input circuit is less than 0.5VA |
| Accuracy | | 0.5 class |
| Function | Display | LED or LCD |
| | Communication | RS485,Modbus-RTU protocol;(1 start bit,8 data bit,1 stop bit,no parity)<br>Baud Rate 2400/4800/9600/19200 bps etc. |
| | Alarm | 1 channel passive relay,contact capacity 3A/30VDC,3A/250VAC,<br>Used for high,low,unbalance alarm etc. |
| | Analog | DC4~20mA,( load <500Ω)<br>(note:Shielded wire is specially selected for the above signal input and output) |
| | switching | Input — 4 channel or 2 channel dry contact Input,built in power supply<br>Output — 2 channel switching output,NO relay contact,capacity: 3A/30VDC,3A/250VAC |
| Auxiliary supply | Voltage range | AC/DC 85-265V |
| | Power consumption | <5VA |
| Insulation resistance | | ≥ 100MΩ |
| Power frequency withstand voltage | | Between power supply set of terminals and signal input,output set of terminals 2kV/1min (RMS)<br>Between the shell and all set of terminals(except the set of terminals reference voltage less than 40V) AC 4kV |
| Environment | Temperature | Operation: -10℃～+55℃Storage: -25℃ ~+70℃ |
| | Humidity | ≤95%RH,no condensation,without corrosive gas |
| | Altitude | ≤ 2500m |

# 4 Installing and wiring

## 4.1 Outline and mounting cut out size (Unit: mm)

Table 3

| Shape | Panel | | Housing | | | Cut out | |
|---|---|---|---|---|---|---|---|
| Unit:mm | Width | Height | Width | Height | Depth | Width | Height |
| 48 Square | 49 | 49 | 44 | 44 | 93 | 45 | 45 |
| 72 Square | 75 | 75 | 66.5 | 66.5 | 94.3 | 67 | 67 |
| 96 Square | 96 | 96 | 86.5 | 86.5 | 77.8 | 88 | 88 |

## 4.2 Diagram of meter and its cut out
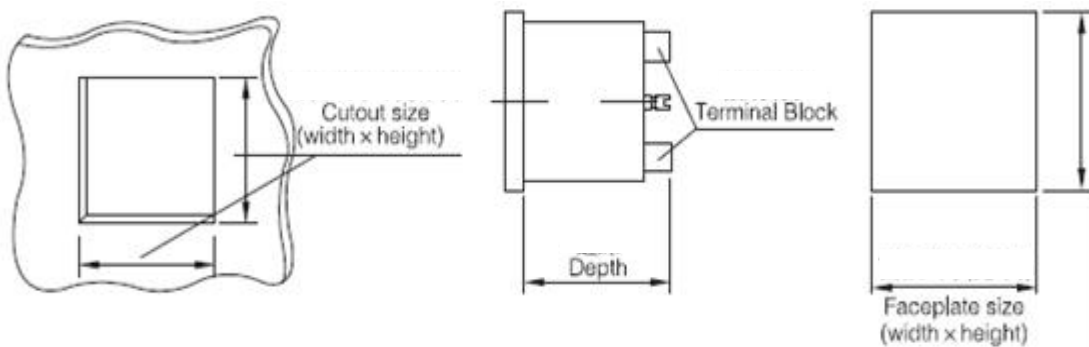


## 4.3 Installing

1) Make holes on distribution cabinets;

2) Take out the meter and the buckle;

3) The meter is loaded into the mounting hole from the front,as shown in Figure 2;

4) Insert the buckleand fix the meter,as shown in Figure 3.



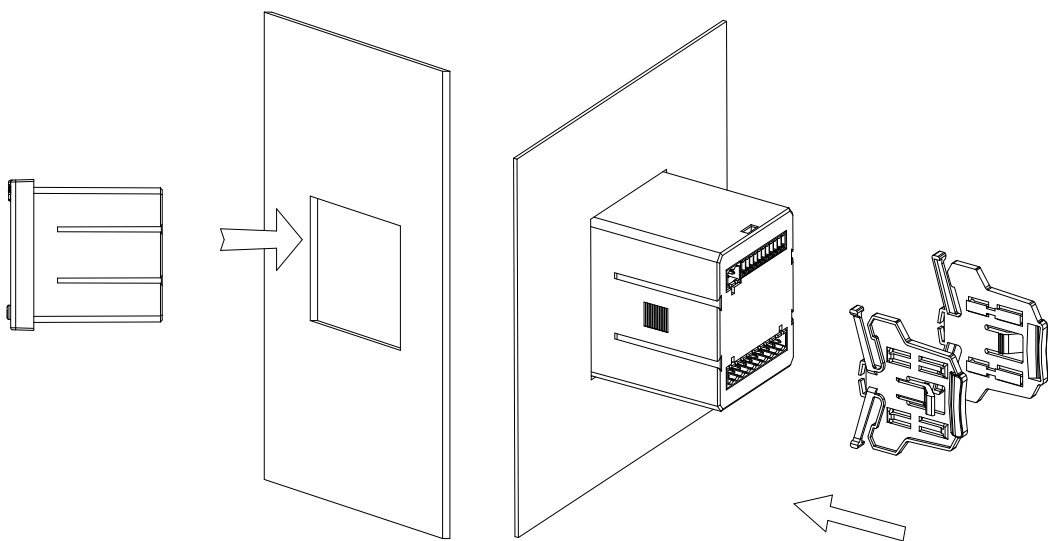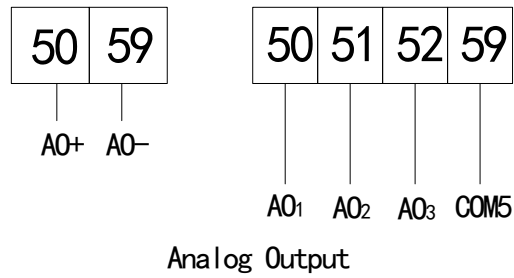图 2                                图 3

## 4.4 Terminals and wiring

According to different design requirements,it is recommended to add a fuse (BS88 1A gG) to the power supply and voltage input terminals to meet the safety requirements of relevant electrical codes.

4.4.1 Terminals and wiring

Analog wiring:

| 50 | 59 |
|----|----|

AO+  AO−

| 50 | 51 | 52 | 59 |
|----|----|----|----|

AO1  AO2  AO3  COM5

Analog Output

Switching input wiring:

| 30 | 31 | 32 | 33 | 39 |
|----|----|----|----|----|

DI1  DI2  DI3  DI4  COM1

| 30 | 31 | 39 |
|----|----|----|

DI1  DI2  COM1
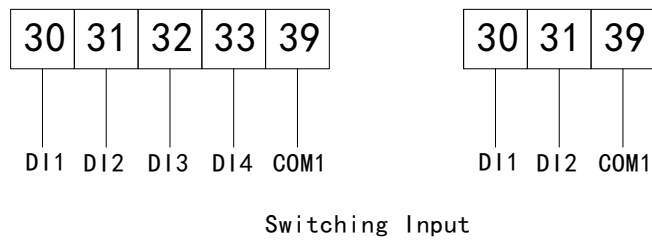
Switching Input

Switching output or alarm wiring:

| 40 | 41 | 42 | 43 |
|----|----|----|----|

+    −    +    −
DO1        DO2
Switching Output

| 42 | 43 |
|----|----|

J

Alarm Output

RS-485 wiring:

| 2 1 | 2 2 |
|-----|-----|

A        B
R S 4 8 5

Power wiring:



Auxiliary Power
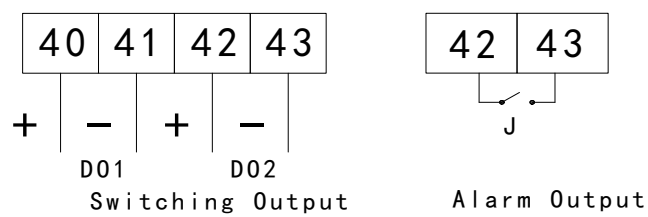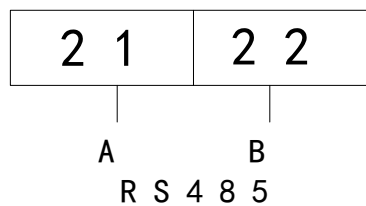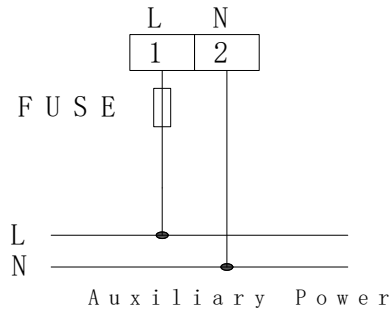
Voltage or current wiring:

single phase:



Current input
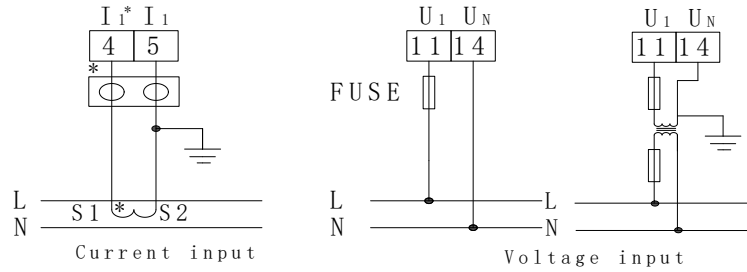
Voltage input

Three phase:

Three phase voltage:



3-phase 3-wire

3-phase 4-wire

AMC72/96 Voltage



3-phase 3-wire

3-phase 3-wire

3-phase 4-wire

AMC48 Voltage

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Three phase current:

| $I_A^*$ | $I_A$ | $I_B^*$ | $I_B$ | $I_C^*$ | $I_C$ |
|---|---|---|---|---|---|
| 4 | 5 | 6 | 7 | 8 | 9 |

*    *    *

A
B
C

S1 * S2
S1 * S2
S1 * S2

DC series:

U+ U-
| 4 | 9 |

FUSE

+
−

DC 1000V input

U+ U-
| 5 | 9 |

FUSE

+
−

DC 300V input

U+ U-
| 6 | 9 |

sensor

+
−

DC 10V input

I+ I-
| 7 | 9 |

+
−
75mV shunt ⟶ Load

DC 75mV input

I+ I-
| 8 | 9 |

+
−

DC 5A input

I+ I-
| 8 | 9 |

sensor

+
−
⟶ Load

DC 20mA input
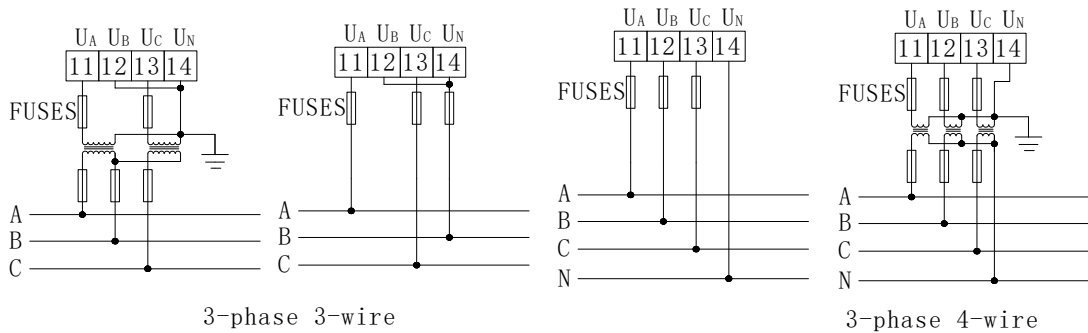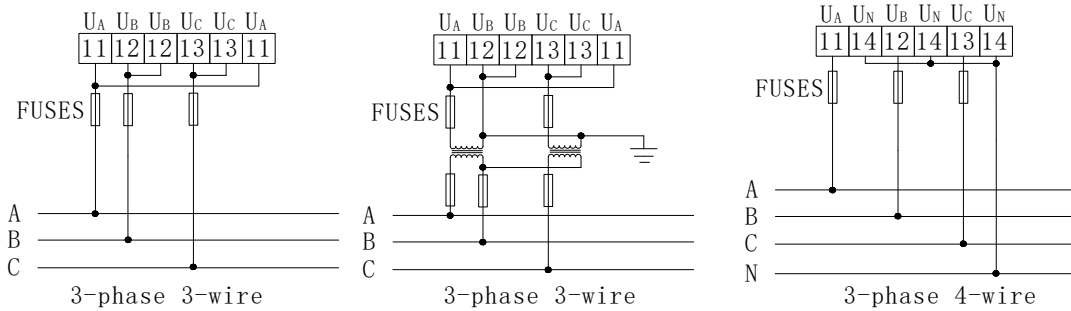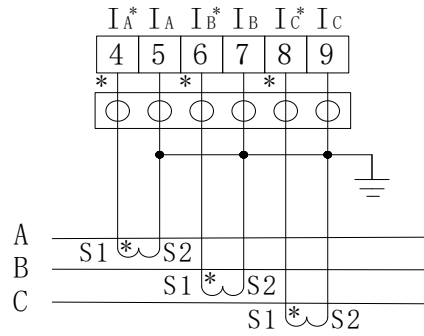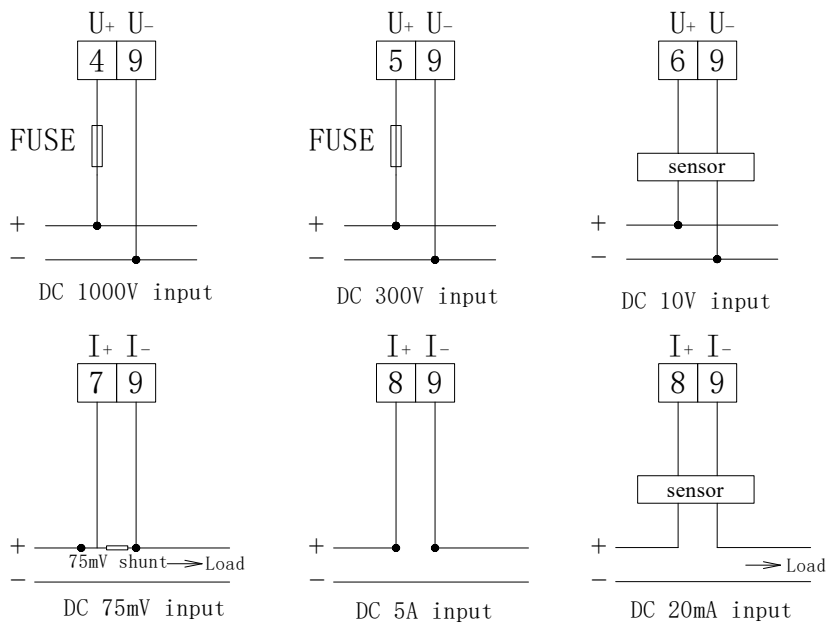
**Note:1. The symbol "*" indicates current input terminal,this wiring is for reference only ,the specific wiring diagram on the meter prevail;**

**2. Alarm output relay duplex with the second switching output (DO2).**

## 4.5 Notice

4.5.1 Voltage Input

The input voltage must not be higher than the rated input voltage of the product ,otherwise PT should be considered

A 1A fuse must be installed on the voltage input.

4.5.2 Current Input

Current input shall use external CT;

If the used CT connected with other meters,the connection should be used in series;

It is recommended to use wiring board ,do not connected with CT directly,in order to remove conveniently；

Before removing product 's current input connection,be sure to disconnect the CT primary circuit or short the secondary circuit.

4.5.3 Additional function wiring

COM of analog output and switching input represent their own common end,it is not earthing actually.

Two-core shield cable is recommended for communication connection. Its wire diameter is not less than 0.5mm2 ,connecting A B respectively ,shielded layer single point to connect the earth or dangling .When wiring,the communication line shall be far away from strong current cable and other strong electric field environment.

For connection mode in communication section are shown as following:



Recommendation of adding matched resistance between A ,B of the last meter,the rated resistance range is 120Ω~10kΩ.
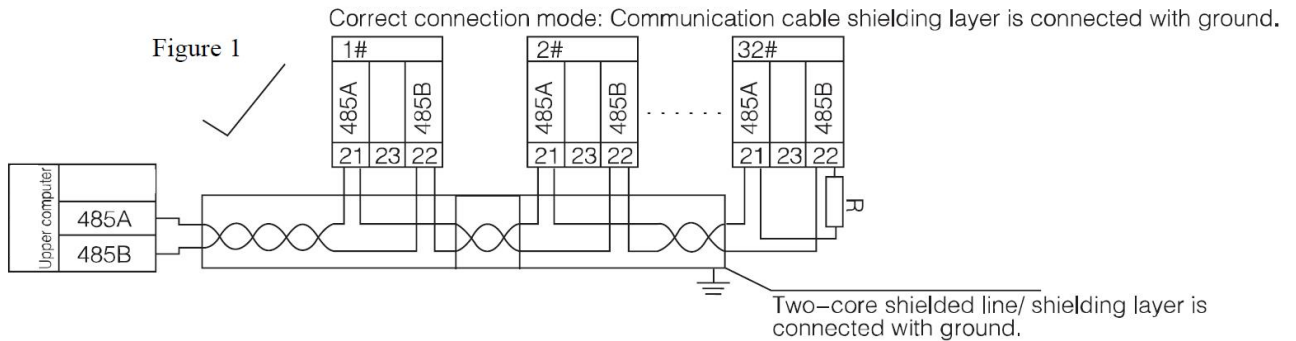
## 5 Operating description

### 5.1 Key function description

Table 4　Key function description

| Key symbol | Function |
|---|---|
| SET ( SET) | Return to previous menu or Function switching |
| Left ( ◀ ) | Same level menu shifting left or reducing data |
| Right ( ▶ ) | Same level menu shifting right or increasing data. |
| Enter ( ← ) | Enter Next level menu or Confirm. |
| Left+ enter( ◀ + ← ) | In programming mode,this key combination is used for the reduction of hundreds of digits. |
| Right + enter( ▶ + ← ) | In programming mode,this key combination is used to increase the hundred digits. |

**Note: When using the combination key,you can firstly press the left or right key and then press the Enter key.**

### 5.2 Programming menu

5.2.1 Menu symbol and its meaning

table 5

| First menu | Second menu | Third menu | Description |
|---|---|---|---|
| **SYS** | **CodE** | 0～9999 | Password setting (initial password 0001) |
| | **bLCd** | 0～255 | LCD backlight control,when set to 0,the backlight is always on,when set to 0-255,the backlight is off after 0-255 seconds |

| | | | |
|---|---|---|---|
| | AL.-F | ON/OFF | Whether the screen flashes when alarming |
| In | LinE | 3P3L,3P4L | Electrical network (3-phase 3-wire,3-phase 4-wire)<br>Note: just for3 phase voltage |
| | In. 1<br>(In.u) | 1A,5A<br>(100V,400V,660V) | Current rated value<br>(Voltage rated value) |
| | In.Ct<br>(In.Pt) | 0～9999 | Current ratio<br>(Voltage ratio) |
| | H | -9999～9999 | Full scale display |
| | L | -9999～9999 | Zero display |
| | U.P(A.P) | 0～3 | Decimal point<br>of current (voltage) display |
| | 2 | -9999～9999 | Shielding value<br>of zero display |
| bUS | Addr | 1～247 | Communication address |
| | bAUd | 1.2,2.4,4.8,<br>9.6,19.2,38.4 | Baud rate<br>(Example 9.6 means 9600bps) |
| | nodE | None/2bit/odd/even | Communication mode<br>(No parity check,2-bit stop bit,odd parity check,even parity check) |
| tr.1-tr.3 | SEL | 1,2,3 | Analog output selection |
| | tYPE | 4～20mA or 0～20mA | Output type |
| | Ao.Hi | 0～9999 | High analog value setting |
| | Ao.Lo | 0～9999 | Low analog value setting |
| do.1-do.2 | SEL | 0.do/1.AL | Alarm selection |
| | dLY | 0～20 | Alarm delay or remote control delay (s) |

| | | | |
|---|---|---|---|
| | *bAnd* | 0～9999 | No action band setting |
| | *AL.Hi* | 0～9999 | High alarm value setting |
| | *AL.Lo* | 0～9999 | Low alarm value setting |
| | *AL.-b* | 0～100 | Unbalance alarm setting (%) |
| | *In.=0* | Lo.on/Lo.of | Whether alarm is allowed when the signal is 0 |
| *UEr* | | | Version |

### 5.3 Setting and use

The programming example introduces some of the options in the programming menu,such as current ratio,analog output setting,and switching output setting etc.

**Note: After the setting or selection is completed,press the Enter key to confirm. After confirming the completion,press the SET key until the SAVE/YES page appears. At this time,you must press the Enter key to confirm,otherwise the setting is invalid.**

5.3.1 How to enter the programming menu

Single phase:

Display interface — *0.000* — SET — Password interface — *PASS* — ↵ — *9999* — Left and right keys to enter the password ◄ ► — *0001* — ↵ — Enter the programming interface — *SYS*

Three phase:

Press the SET key to enter the password interface — *PASS* — ↵ — *PASS* / *9999* — Enter the password with left or right key ◄ ► — *PASS* / *0001* — ↵ — Enter the programming interface — *SYS*
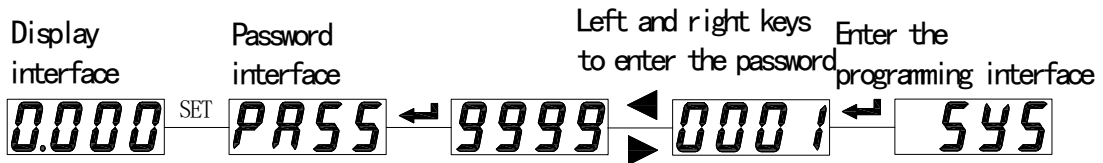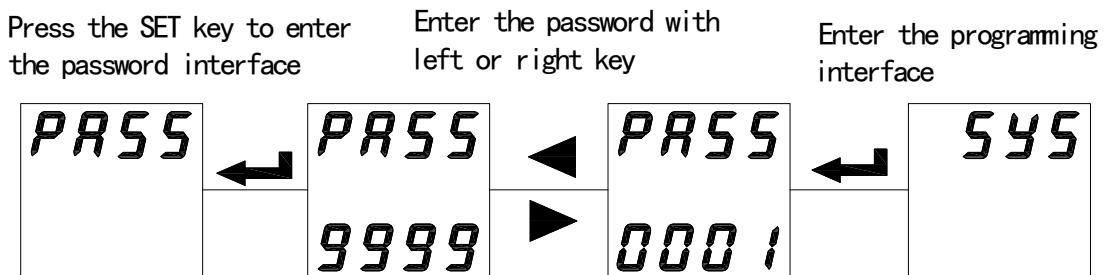
5.3.2 How to save the modified parameters

Single phase:

Press the Enter key to save the setting, or
press the SET key to return to return

$In.=0$ ↵ $Lo.on$ ↵ $In.=0$ SET $do.1$

SET

$0.000$ ↵ $SAuE$

Press the Enter key
to save the settings

Three phase:

Press the Enter key to save
the setting, or press the
SET key to return to return

Press the SET key to return
to the first level menu.

$do.1$
$In.=0$
$Lo.on$
← $do.1$
$In.=0$
SET $do.1$

SET

$0.000$
$0.000$
$0.000$
← $SAuE$
$YES$

Press the Enter
key to save the
settings
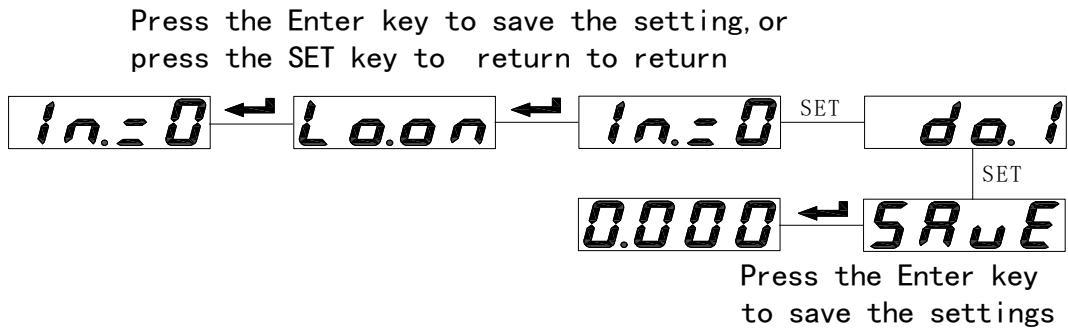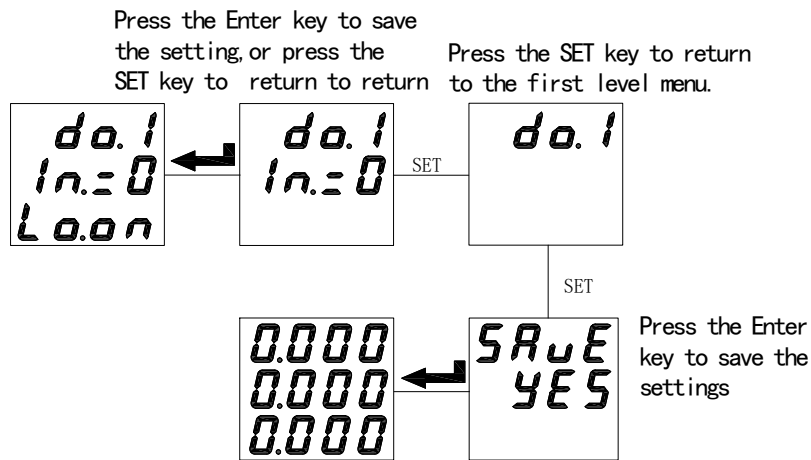
**Note: You do not need to save the parameter aftermodifying one. You can save all the parameters after modifying them as described above.**

5.3.3 How to modify the password,backlight time etc.

Single phase:

Password setting    Backlight setting    Whether the screen
flashes when alarming

$SYS$ ↵ $CodE$ ◄► $b.LCd$ ◄► $AL.-F$

↵ ↵ ↵

$0001$ $0000$ $oFF$

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Three phase:

Password settings    Backlight setting    Whether the screen flashes when alarming

```
     SYS          SYS        SYS        SYS
                  CodE   ◄   b.LCd  ◄   AL.-F
                         ►          ►
                  ↵          ↵          ↵
                  SYS        SYS        SYS
                  CodE       b.LCd      AL.-F
                  0001       0000        on
```
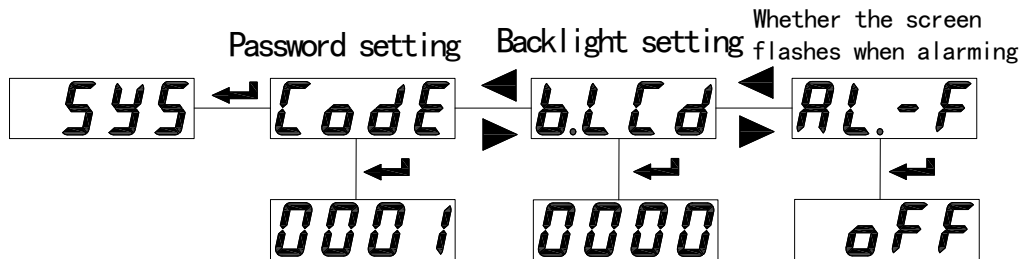
Use the left or right key    Use the left or right key to
to modify the password       modify the backlight time.
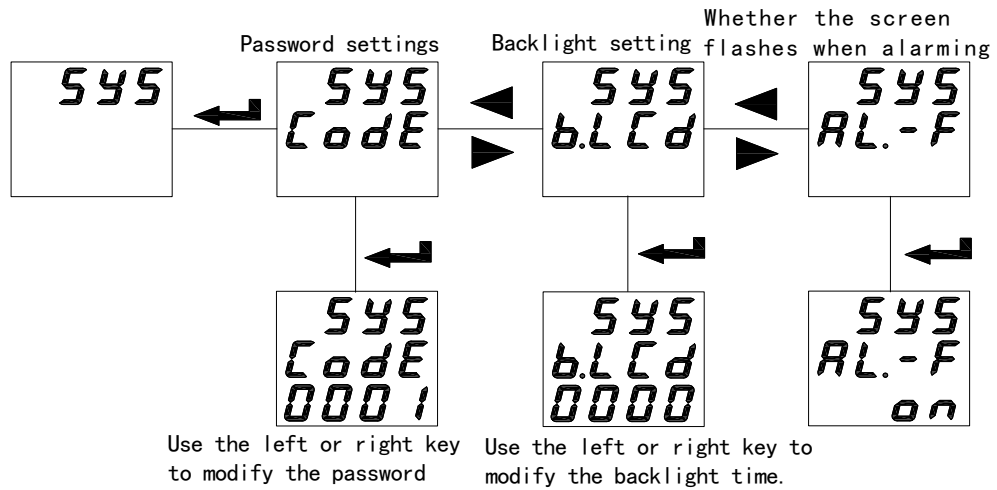
Enter the programming menu,press left or right key to select the LCd page,press Enter key to enter revising condition,left or right key to modify the time to 000 ~ 255s.To LED display meter,this item is invalid.

000: the LCD backlight is always on;

250: the LCD backlight has no backlight after 250 seconds,and the backlight is turned off to extend the life of the backlight.

5.3.4 How to modify the current rated value and current ratio

Single phase:

Modify current rated value    Modify current ratio

```
  SYS  ◄    In   ↵   In. 1  ◄   In.Ct
       ►                     ►
                     ↵            ↵
                     1A          0001
```

Three phase:

Modify current rated value

Modify current ratio

```
 5 4 5        In          In          In
                        In. 1        In.Ct
```

Use the left or right key to modify the current rated value

```
   In           In
 In. 1        In.Ct
   5 A         9 9 9 9
```

Use the left or right key to modify the current ratio
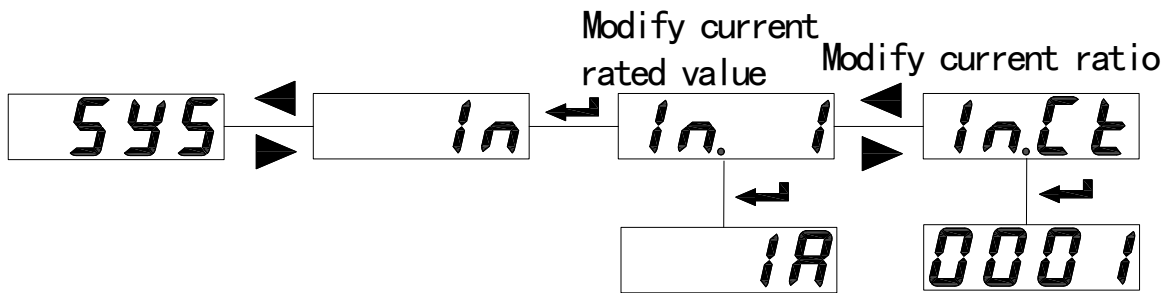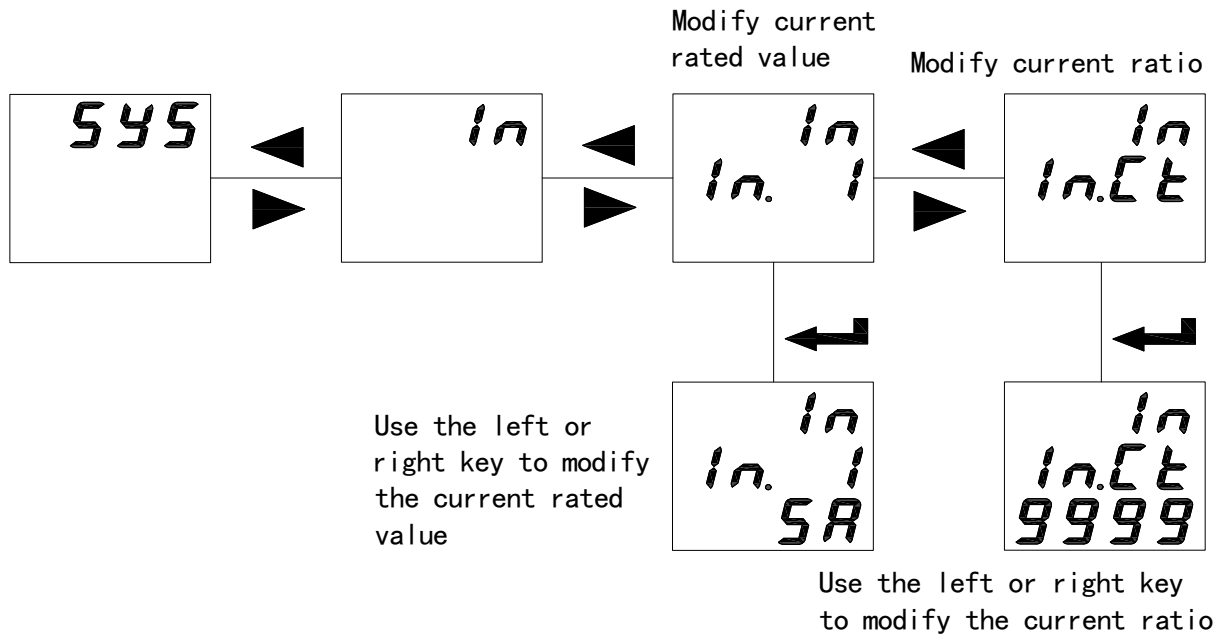
**Note: IN.I is the current rated value ,IN.U is the input voltage rated value; IN.CT is the current ratio,and IN.PT is the voltage ratio.**

5.3.5 How to modify the DC display value

```
      5 4 5
       In
```

Full scale display      Zero display      Decimal point      Shielding value of zero display

```
   H            L           A.P            2
 1 0 0 0      0 0 0 0     0 0 0 3      9 9 9 9
```
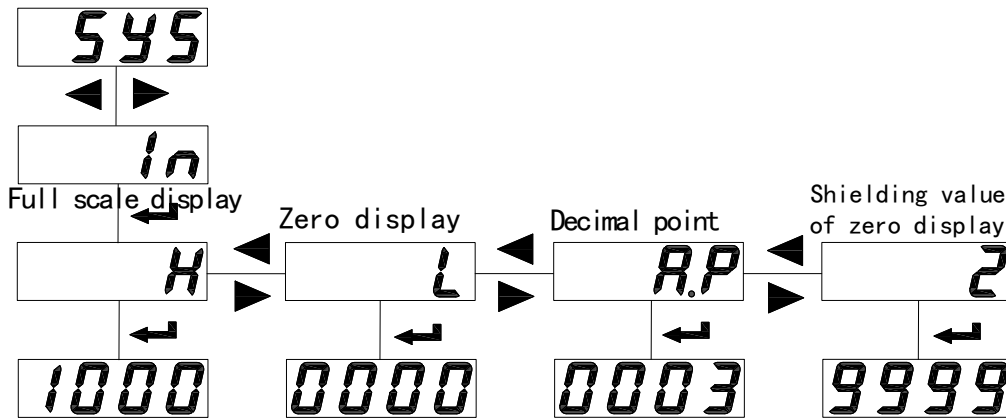
The DC voltage meter is the same,only one difference: U.P replaces A.P;

When the zero shielding value is set to positive,it means that if | display value | $\leqslant$ set value,the display value is 0(Fig. 6); When the set value is negative,then the display value is set value when the display value $\leqslant$ set value (Fig. 7).
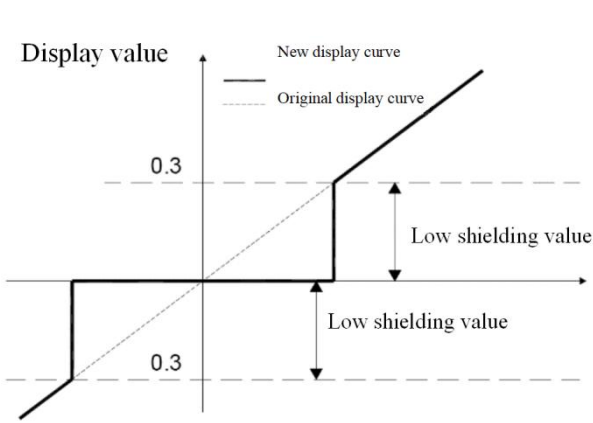
图 6
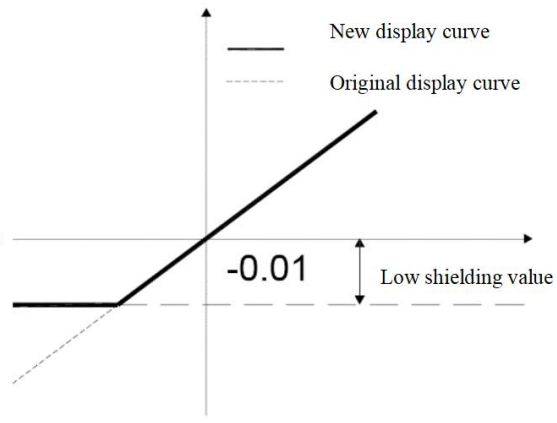


图 7

**DC meter setting**

**H:** DC high point display value; **L:** DC zero point display value,**A.P (U.P):** Display decimal point

**When the low point of the input is 0:**

For example:The input signal is 0-75mV,and the relative display needs to be 0-1000A,then the setting will be:H: 1000,L: 0,A.P: 0.So when the input is 37.5mV,the display will be 500 ((1000-0)*(37.5/(75-0))).

**When the low point of the input is not 0:**

For example: The input signal is 4-20mA,and the display needs to be 0-60.00Hz,then the chart of the relationship will be as follows:
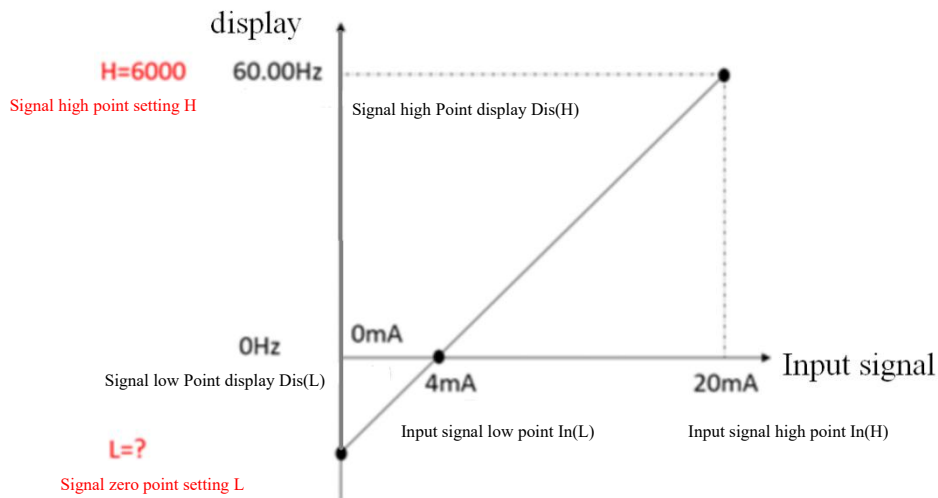


Setting: H: 6000,fiWe can get L according to the chart: (In (H)-In (L))/In (L) = (Dis (H)-Dis (L))/ (Dis (L)-L). So L= 0 – (6000-0) * 4 / (20 – 4)= -1500.

A.P:2; so when the input is 4 mA,the display will be (6000-0) * (4/20) + (-1500) = 0Hz

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5.3.6 How to modify the communication address,communication baud rate and communication mode

Single phase:



Three phase:



| | | Modify address | Modify baud rate | Modify mode |
| | | Use the left or right key to modify the communication address. Address range:1-247 | Use the left or right key to modify the communication baud rate. | Use the left or right key to choose the communication mode: None/2bit/odd/even |
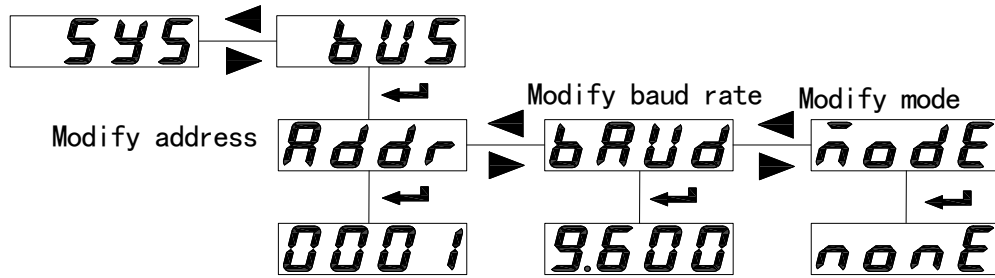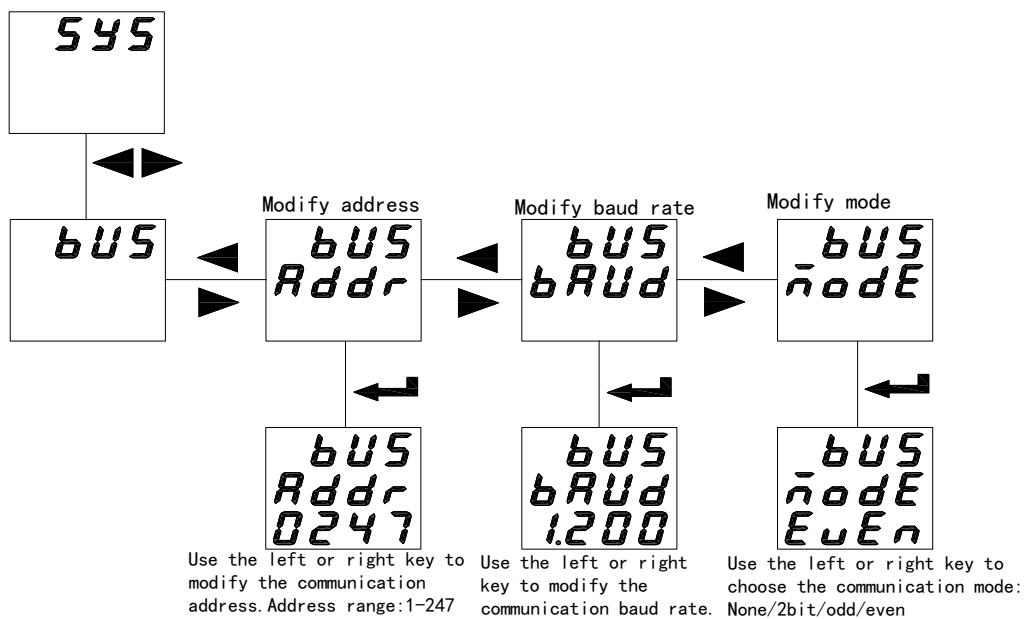
5.3.7 How to modify the analog output parameter,the output range and the high and low values

Table 6

| tr.1 | First analog output | | |
|------|------|------|------|
| SEL | Analog output selection | | |
| | 0001 | 0002 | 0003 |
| | U1/I1 | U2/I2 | U3/I3 |
| tYPE | 4～20mA or 0～20mA | | |
| Ao.Hi | When the analog output is 20mA,the corresponding electrical parameter is taken as the highest four-digit integer (the decimal point is ignored) and the last bit is zero. | | |
| Ao.Lo | Same as Ao.Hi | | |

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Single phase:

```
          5 4 5
            ↵
   tr.1  ◄► tr.2  ◄► tr.3
```
Analog output selection   Modify output type   High value setting   Low value setting
```
   SEL  ◄► tYPE  ◄► Ao.H i  ◄► Ao.Lo
    ↵        ↵         ↵          ↵
  000 1    4-20     1.000      1.000
```

Three phase:

```
          5 4 5
           ◄►
   tr.1  ◄► tr.2  ◄► tr.3
            ↵
```
Analog output selection   Modify output type   High value setting   High value setting
```
   tr.1   ◄►  tr.1   ◄►  tr.1    ◄►  tr.1
   SEL        tYPE       Ao.H i      Ao.Lo
    ↵          ↵          ↵           ↵
   tr.1       tr.1       tr.1        tr.1
   SEL        tYPE       Ao.H i      An.Lo
  000 1      4-20       5.000       1.000
```
Use the left or right key to modify the analog output selection | Use the left or right key to modify the output range. TYPE:4～20mA or 0～20mA | Use the left or right key to set the high value. | Use the left or right key to set the low value

5.3.8 How to modify the alarm item,set the alarm delay,set the high and low alarm value and the unbalance alarm setting (1 way alarm is the same as 2 way alarm)

Table 7

| do. 1 | First switching output |
|---|---|
| SEL | Alarm setting<br><table><tr><td>0.do</td><td>1.AL</td></tr><tr><td>remote control</td><td>alarm</td></tr></table> |
| dLY | When the SEL is 00 (remote control),DLY indicates the duration after the switching amount is activated.<br>When the alarm item SEL is not 00 (alarm),DLY indicates the delay time before the switching action. |

| | |
|---|---|
| bAnd | No action band setting |
| AL.Hi | High alarm value setting (do not set the maximum 9999) |
| AL.Lo | Low alarm value setting (do not set minimum 0) |
| In.=0 | Whether low alarm is allowed when the signal is 0,Lo.on is enabled,Lo.of is forbidden |

Single phase:

Alarm selection

| SYS | do.1 | SEL | 0. do |

Alarm delay time

| do.2 | dLY | 000.3 |

No action band setting | bAnd | 0.001 |

High alarm value | AL.Hi | 9999 |

Low alarm value | AL.Lo | 0.000 |

Whether alarm is allowed when the signal is 0. | In.=0 | Lo.on |

Three phase

```
              ┌─────────┐
              │   SYS   │
              └─────────┘
```

Enter alarm selection

Use the left or right key to modify the alarm:selection:0.do,1.AL

```
┌──────┐      ┌──────┐      ┌──────┐
│ do.1 │  ←   │ do.1 │  ←   │ do.1 │
└──────┘      │ SEL  │      │ SEL  │
              └──────┘      │ 1.AL │
                            └──────┘
```

Alarm delay time

Use the left or right key to modify alarm delay time,range:0-20

```
┌──────┐      ┌──────┐      ┌──────┐
│ do.2 │      │ do.1 │  ←   │ do.1 │
└──────┘      │ dLY  │      │ dLY  │
              └──────┘      │ 0020 │
                            └──────┘
```

No action band setting

Use the left or right key to modify no action band value

```
┌──────┐      ┌──────┐
│ do.1 │  ←   │ do.1 │
│ bAnd │      │ bAnd │
└──────┘      │ 1.000│
              └──────┘
```

High alarm setting

Use the left or right key to modify high alarm value

```
┌──────┐      ┌──────┐
│ do.1 │  ←   │ do.1 │
│ AL.Hi │      │ AL.Hi │
└──────┘      │ 1.000│
              └──────┘
```

Low alarm setting

Use the left or right key to modify low alarm value

```
┌──────┐      ┌──────┐
│ do.1 │  ←   │ do.1 │
│ AL.Lo │      │ AL.Lo │
└──────┘      │ 5.000│
              └──────┘
```

Unbalanced alarm setting

Use the left or right key to modify unbalanced alarm value

```
┌──────┐      ┌──────┐
│ do.1 │  ←   │ do.1 │
│ AL.-b │      │ AL.-b │
└──────┘      │ 0100 │
              └──────┘
```

Whether alarm is allowed when the signal is 0.

```
┌──────┐      ┌──────┐
│ do.1 │  ←   │ do.1 │
│ In.=0 │      │ In.=0 │
└──────┘      │ Lo.on │
              └──────┘
```

**Note: 1. No action band setting,high alarm value setting and low alarm value setting correspond to the display value of the meter,and the value contains a decimal point. Example: Input 100A/5A,100% current high alarm,95% return; 20% current low alarm,25% return,"AL.Hi"taken as 100.0,"AL.Lo"taken as 020.0,"bAnd"taken as 005.0;**
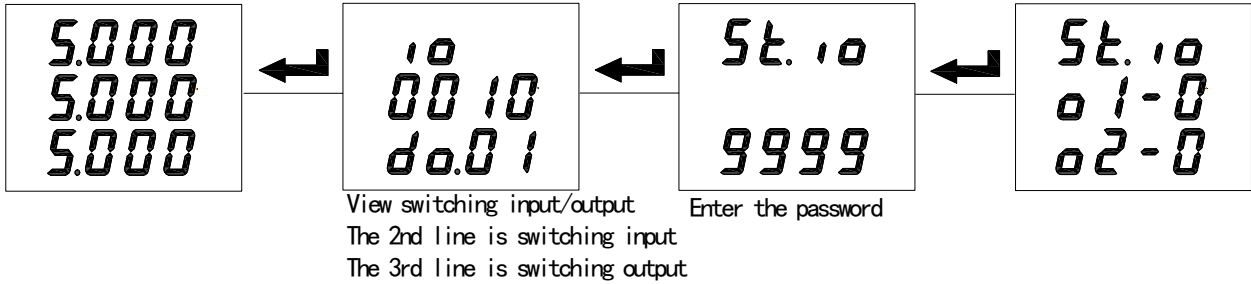
**2.Unbalancecalculation**

(maximum value–minimum value)/rated value (average value is less than rated value)

(maximum value–minimum value)/average value (average value is greater than or equal to the rated value)
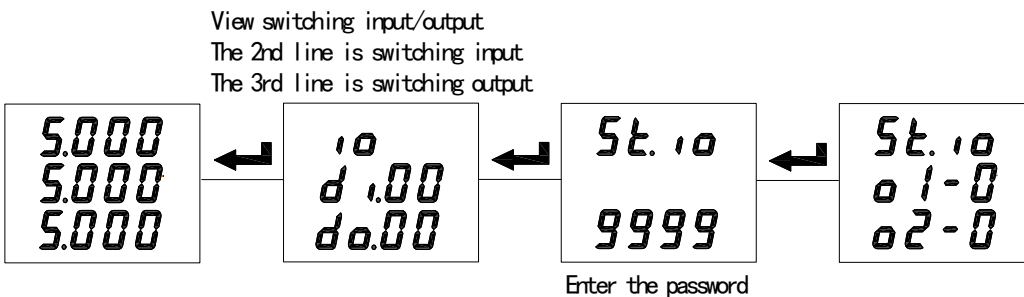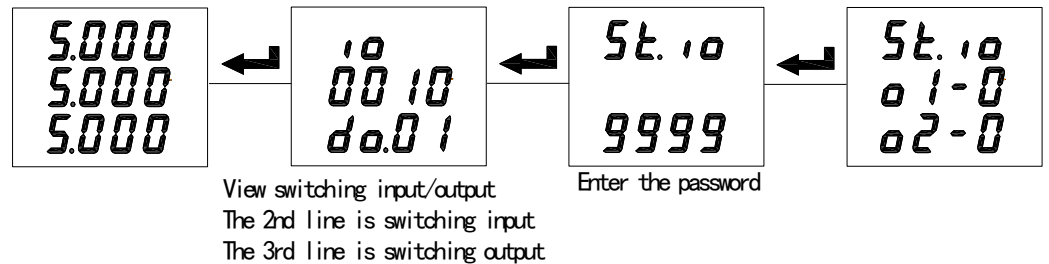
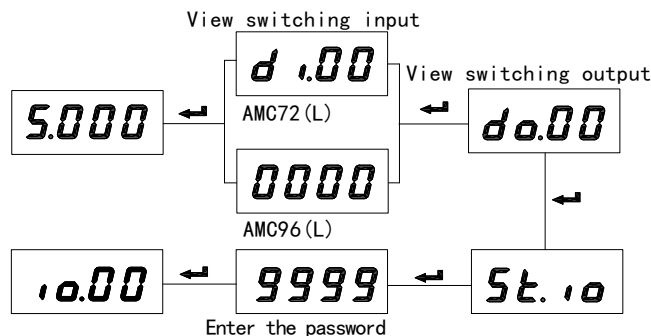## 5.4 View switching display and alarm status

5.4.1 View switching

View the switching status of AMC96 (L) three-phase current meter (same three-phase voltage meter):

```
5.000        io          St.io        St.io
5.000   ←    0010   ←    9999    ←    o1-0
5.000        do.01                    o2-0
```

View switching input/output   Enter the password
The 2nd line is switching input
The 3rd line is switching output

View the switching status of AMC72 (L) three-phase current meter (same three-phase voltage meter):

```
5.000        io          St.io        St.io
5.000   ←    0010   ←    9999    ←    o1-0
5.000        do.01                    o2-0
```

View switching input/output   Enter the password
The 2nd line is switching input
The 3rd line is switching output

View switching input/output
The 2nd line is switching input
The 3rd line is switching output

```
5.000        io          St.io        St.io
5.000   ←    di.00  ←    9999    ←    o1-0
5.000        do.00                    o2-0
```

Enter the password

View the switching status of AMC72/96(L) single-phase current meter(same single-phase voltage meter):

View switching input
```
        di.00   ┐   View switching output
5.000 ← AMC72(L)  ←   do.00
        0000
        AMC96(L)              ↵
io.00 ← 9999    ←    St.io
        Enter the password
```

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The liquid crystal (LCD) display meter has a switching input/output indication under normal measuring condition,without pressing the shortcut key to look over.

When look over switching condition page,press down ENTER,Enter local switching output (relay)control page (St. io),press left/right key to enter protective password (Default Value; 0000),press ENTER to confirm enter;the data flashes indicate revisability,press left key to select revising item,press right key to do revising,press ENTER to confirm revising; If Control two channel relay is needed,firstly,finishing all the revising,then press ENTER to confirm.

### 5.4.2 View alarm status

Alarm status (for normal measurement,press and hold the right shift key to view the alarm information)

AMC72/96 series single-phase meter alarm status:

| normal | I too high | I too low | No alarm when the value is 0 |
|--------|-----------|-----------|------------------------------|

AMC72/96 series three-phase meter alarm status:

| normal | U1(I1) is too high | U3(I3) is too low | Unbalanced or none-full phase | No alarm when three-phase data is 0 |
|--------|--------------------|--------------------|-------------------------------|-------------------------------------|

## 6 Communication

### 6.1 Summary

AMC Series meter adopt Modbus-RTU protocol: "9600,8,n,1",in it 9600 is default baud rate,based on request,it can be revised as 2400,4800 ,19200 etc.,8 indicate have 8 data bit; n indicate no parity bit; 1 indicate have one stop bit.

Error detecting: CRC16 (cyclic redundancy check)

### 6.2 Protocol

When Data frame reach terminal device,it enter addressed device by a simple "port",this device remove Data frame "envelope"(data head),read data,if there is no error,executing task requested by data,then,add the new produced data in the obtained "envelope",return the data frame to the transmitter. Returned responding data include following content: slave terminal address (Address),executed command (Function),requested data produced by executing command (Data) and one CRC check code (Check). If any error occur,no successful responding or returning one error indication frame.

### 6.2.1 Data frame format

| Address | Function | Data | Check |
|---------|----------|------|-------|
| 8-Bits | 8-Bits | N×8-Bits | 16-Bits |

6.2.2 Address domain

Address domain: address domain is located at beginning of frame,composed of one byte (8 bit binary system domain),decimal system is 0-255,in our system,just 1-247 is used,other address is Reserved,these bits indicate terminal device address specified by users,this device will receive the connecting host computer data. Every terminal device has its only one address,only the addressing terminal is responding enquiry including this address. When terminal is Transmitting one responding,the responding slave address data tell host computer that which terminal is communicating with it.

6.2.3 Function domain

Function domain: function domain tell the addressed teminal to excute what function, Below table list: function domain used in this Series meters,and their meaning and function.

| Code(hex) | Meaning | Operation |
| --- | --- | --- |
| 03H | Read holding register | Obtain current binary system value of one or multiple holding register |
| 10H | Present multiple register | Set actual binary system value into a series of continuous holding register |

6.2.4 Data fields

Data field: data field is including the data needed by terminal for executing specific function,or the collected data when terminal is responding enquiry .Content of these data may be value,reference address or setting value.

For example: The function domain tell terminal to Read one register,the data field need to specify the starting register and Read how many data,the built-in address and data have different content depending on type and slave computer.

6.2.5 Error check domain

This domain adopt CRC16 cyclic redundancy check,for host computer and terminal,the error in checking and transmitting is allowable. Due to electric noise and other interfere,when one group of data is transmitting from one device to another device,on the transmitting line,some change may be produced. The error check can enable the host computer or slave computer not responding those changed data,so,safety,reliability and efficiency of system are upgraded.

**6.3 Method to create error check code (CRC)**

Error check (CRC) domain occupy 2 byte,including one 16 bit binary system value. CRC value is calculated by transmission device,then attached to the data frame,the receiving device,while receiving,it calculates the CRC value again,then comparing it with the receiving CRC domain value,if these two values is not equal,it shows a error occurs.

When operating,firstly,preset one 16-bit register as All-1,then continuously operating each byte 8 bit of Data frame and current value of this register,only every 8 data bit of each byte to participate in forming CRC the start bit and stop bit and usable parity bit have no affect on the CRC. When forming CRC,every 8 data bit of each byte and content of register carry out exclusive or operation,then shift the result to the low bit the high bit is filled with 0,shift out the least significant bit (LSB) is shifted out and tested,if it is 1, this register and one preset fixed value (0A001H) carry out one exclusive or operation,if the least significant bit is 0,no treating is needed.

Flow for forming one CRC:

1.Preset one 16 bit register as OFFFFH (All-1),called as CRC register.

2.8 bit of data frame first byte and low byte of CRC register carry out exclusive or operation,then save its result back to CRC register.

3.Right shift CRC register for one bit,the most significant bit is filled with O,the least significant bit is shifted out and tested.

4.If the least significant bit is 0,Repeat the third step (next shift); If the least significant bit is 1,CRC register and preset fixed value specified (0A001H) carry out exclusive or operation.

5.Repeat the third step and the fourth step until shift for 8 times,the complete 8 bit is done.

6.Repeat the second step to the fifth step to treat next 8 bit until all the byte is treated.

7.The CRC register final value is CRC value.

Besides,there is another CRC calculation method by preset table,its main feature is fast calculating speed,but large saving space is needed,please refer to related data

## 6.4 Communication parameter address meter (Word)

6.4.1 Communication parameter address meter (word)

Table 8

| Address | Content | | Brief Explanation | Brief Explanation |
|---|---|---|---|---|
| | Single phase | Three phase | | |
| 0000H | Ua effective value | Ua effective value | | Read/Write:R-read;W-write The 002aH is partial writable,the rest is read-only. |
| 0001H | Ua exponent bit | Ua exponential | | |
| 0002H | Ia effective value | Ub effective value | | |
| 0003H | Ia exponent bit | Ub exponential | | |
| 0004H | | Uc effective value | | |
| 0005H | | Uc exponential | | |
| 0006H | | Ia effective value | | |
| 0007H | | Ia exponential | | |
| 0008H | | Ib effective value | | |
| 0009H | | Ib exponential | | |
| 000aH | | Ic effective value | | |
| 000bH | | Ic exponential | | |
| .... | — Reserved word | | | Explanation: ①"—"indicate Reserved word or Reserved bit. ②voltage,current etc. data numerical value Computing Method: Reading = Effective value $\times 10E(\text{ Exponential-3})$ |
| 0010H | PT | | Voltage ratio | |
| 0011H | CT | | Current ratio | |
| 0012H | Alarm and I/O | | | |
| … | — Reserved word | | | |
| 002aH | | Alarm and I/O | | |
| 002bH | | PT | Voltage ratio | |
| 002cH | | CT | Current ratio | |
| … | — Reserved word | | | |
| 0060H | UA voltage | | UL-N when three-phase three-wire | Type of data: float Unit:V |
| 0061H | | | | |
| 0062H | UB voltage | | UL-L when three-phase three-wire | |
| 0063H | | | | |
| 0064H | UC voltage | | Single phase voltage meter:only UA | |
| 0065H | | | | |
| 0066H | IA current | | Three phase meter | Type of data: float |

| 0067H | | Three phase current | Unit:A |
|---|---|---|---|
| 0068H | IB current | Single phase current | |
| 0069H | | meter :only IA | |
| 006AH | IC current | | |
| 006BH | | | |

Description:

Voltage and current calculating method: (example see6.5.1Reading data)

Reading = virtual value×10E(exponent bit-3)

Alarm switching input / output status Character:

| 15 | … | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| — | | | AL.L | AL.H | DI1 | DI2 | — | | — | | DO1 | DO2 |
| (R) H,L alarm indication | | | | | (R) 1 closing,0 opening | | | | (R/W) 1 closing,0 opening | | | |

| 15 | … | 13 | 12 | 11 | 10 | 9 | 8 | 7 | … | 0 |
|---|---|---|---|---|---|---|---|---|---|---|
| — | | | H.L | A.-H | A.-L | U.-H | U.-L | Switching input/output status | | |
| | | | Low power factor alarm | High,Low alarm of current | | High,Low alarm of voltage | | Same as above | | |

## 6.5 Communication application

Actual example,the whole way adopt format of below table (data as Hex)

| Addr | Fun | Data start | | Data #of | | CRC16 | |
|---|---|---|---|---|---|---|---|
| | | reg Hi | reg Lo | reg Hi | reg Lo | Lo | Hi |
| 01H | 03H | 00H | 00H | 00H | 06H | C5H | C8H |
| Address | Function code | Data start address | | Data read number | | CRC code | |

### 6.5.1 Read data

Example 1: Read Three phase voltage meter data

| Inquiry Data frame | 01 03 00 00 00 06 c5 c8 |
|---|---|
| Return Data frame | 01 03 0c 08 ab 00 02 08 ac 00 02 08 ac 00 02 1b 05 |

Explanation:

01: Slave address

03:Function code

0c: Hex,Decimal as 12,indicate: 12 byte data rearwards

1b 05: cyclic redundancy check code

Data processing method see: 6.4 communication parameter address meter

Processing as follows: 08 ab(hex)=2219(decimal)

08ac (hex)=2220 (decimal)

0002 (hex)=2 (decimal)

Calculation: $2219×10^{2-3} = 221.9$; $2220×10^{2-3}= 222.0$

Unit: Volt (V)

Meter display:

| U1 | 221.9 |
|----|-------|
| U2 | 222.0 |
| U3 | 222.0 |

Reading voltage meter data is similar with that of reading current meter,but starting address is 06H,Query frame: 01 03 00 06 00 06 25 c9

Reading inquiry frames of other information is same as this format,each information address see: 6.4 communication parameter address meter.

Example2: Read single-phase current data

| Inquiry Data frame | 01 03 00 02 00 02 65 cb |
|--------------------|-------------------------|
| Return Data frame | 01 03 04 03 b2 00 00 5a 50 |

Description:

01: Slave address

03: Function code

04: Hex,decimal system is 4,means there are 4 byte data

5a 50:Cyclic redundancy check code

Data processing method see:6.4 communication parameter address table

Data processing:03 b2 (Hex) = 946 ( decimal system)

00 00( Hex) = 0 (decimal system)

Calculation: $946 \times 10^{0-3} = 0.946$;

Unit: A

Display:

| I | 0.946 |
|---|-------|

6.5.2 Write data

Example3: Single phase switching output remote control (control character: 0012H)

| Read in data frames | 01 10 00 12 00 01 02 00 02 24 e3   (DO1 closing) |
|---------------------|--------------------------------------------------|
| | 01 10 00 12 00 01 02 00 01 64 e2   (DO2 closing) |
| | 01 10 00 12 00 01 02 00 03 e5 23   (DO1,DO2 closing) |
| Return Data frame | 01 10 00 12 00 01 A1 CC(If no data returning indicate setting is unsuccessful) |

Description:

To switching output status bit,remote write in 1,then closing; read in 0,then opening.

When relay closing duration is Nonzero,indicate: relay adopt pulse mode,relay closing duration as setting value; if duration setting as 0,then indicate: relay adopt holding mode.

Example 2: Three phase switching output remote control (control word: 002aH)

| Setting Data frame | 01 10 00 2a 00 01 02 00 02 20 5b (DO1 closing) |
|--------------------|------------------------------------------------|
| | 01 10 00 2a 00 01 02 00 01 60 5a (DO2 closing) |
| | 01 10 00 2a 00 01 02 00 01 60 5a (DO1,DO2 closing) |
| Return Data frame | 01 10 00 2a 00 01 20 01 (If no data returning indicate setting is unsuccessful) |

# 7 Common fault analysis

Table 9    Common Fault Analysis

| Fault content | Analysis | Remarks |
|---|---|---|
| No display after power on | Check Aux power voltage is within the range | |
| Voltage or current is incorrect | Check the voltage/current ratio<br>Check voltage transformer/current transformer is intact | |
| Communication failure | Check whether the address,baud rate,check digit,etc. in the communication settings are consistent with the host computer.<br>Check RS485 converter is working<br>Add resistance at the end of communication<br>Check wiring is correct | |