SPMK

SPMK223

Beijing Spake Technology Co.,Ltd.

SPMK223 Digital Pressure Calibrator

User's Manual

[Version：V1.0]

Content

1 Introduction

SPMK223 intelligent digital pressure calibrator is a powerful portable digital pressure instrument. It is for measuring pressure, current, voltage, and also has function of ambient temperature, time and DC24V power output. It uses a large section of code blue / white backlit LCD display, multiple measurements simultaneously. It combines the universal application of the majority of users, it also provides a variety of additional function, such as pressure leak detection, multiple trigger of pressure switches, pressure peaks records, documents storage and export. Man-machine interface using a common navigation button design, It is very simple and convenient to operate the instrument. In addition, it uses a removable high-capacity rechargeable lithium battery and external power supply adapter technology to solve the problem of short-time -continuous use. With standard HART interface, it can calibrate pressure transmitter of EJA, E + H, ABB and Rosemount. It can be used to calibrate pressure transmitters, pressure switches, precision pressure gauges, common pressure gauge, blood pressure monitors, pressure sensors and other pressure instruments. It has been widely used in the fields of aviation, aerospace, military industry, metallurgy, electric power, petroleum, chemical, food, pharmaceutical, measuring instruments enterprises and other organizations and other calibration department.

2 Technical Indicator

Pressure measurement range: (-0.1~250) MPa;

Accuracy: ±0.05%FS, some ±0.02%FS;

Operating environment: Temperature: (0~50) ℃;

Relative humidity: ≤90%RH;

Atmospheric pressure: (86~101) kPa;

Power supply: inside battery or specific adapter;

Battery working times: about 40 hours, 24V load will be short accordingly;

Battery charging time: About 4 hours;

Power adapter: AC220V turn DC10V/2A，standard hole of ¢ 4 mm;

External dimension: header（ ¢ 120×45）mm，overall length 190mm;

Weight: 0.70kg;

Electrical-air connection: Measuring connection standard Ø4mm jack;

Output connection standard Ø4 mm jack;

Charging connector standard 4 mm jack;

RS232 connector Standard DB9 socket;

Pressure Connection: ordinary gauge interface is M20 × 1.5mm; differential pressure gauge interface use quick connector, use the 4.00 mm diameter plastic hose;

Signal output: Serial port RS232,connector Baud rate 1200，2400，4800，9600 as options, data length 8 digits; Stop bit 1or 2; Instrument addresses 1-112 single byte. HART communication interface, communication Baud rate 1200;

Communication distance: Connecting wire diameter is greater than 0.6mm，max communication distance is 3～5m;

Calibration period: 1year.

3 Executive Standards

Q/CPSPK0001-2016 SPMK series intelligent digital pressure calibrator and precision digital pressure gauge (digital pressure gauge)

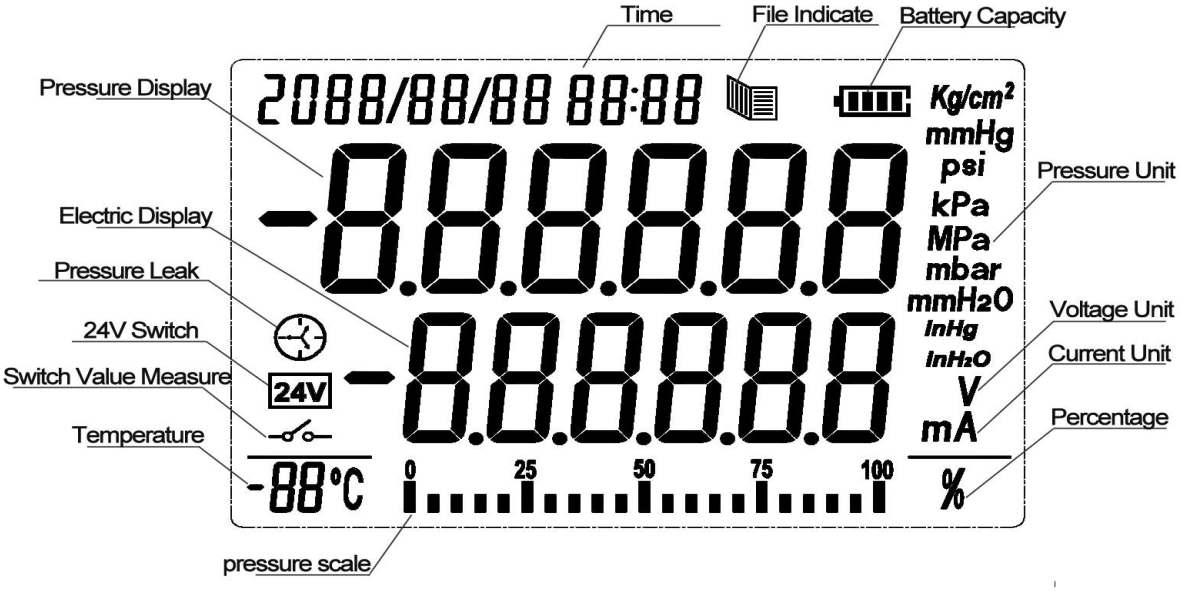
JJG875-2005 Digital pressure gauge calibration regulation

4 Key Component Information

4.1 Liquid Crystal Display

Large LCD display with blue / white backlit, pressure / electrical logging / battery capacity and other measurements displayed simultaneously; also, can indicate the percentage of the pressure; under the File menu mode, the percentage of the scale will be changed into the percentage of the capacity of the storage data. After exiting the File menu mode, It shows the percentage of pressure again; under pressure measurement mode, there are 11 pressure units as option for users: kg/cm^2 / inHg / inH_2O / Pa / kPa / MPa / bar / mbar / psi / mmHg / mmH_2O.

Screen regionalism:



4.2 Circuit Board

Compact structure of power boards, main boards. Electrical signals are used double-pin connection. Electrical connection has good reliability and safety, easy assembly, circuit boards are made of three paint spray and high temperature aging process rigorous treatment, and it can be used for a long time

4.3 Sensor

Sensors have characteristics of high stability, high precision. According to the different pressure range, we buy from very well-known sensors manufacturers.

Pressure Range: (- 0.1 ~ 250) MPa Optional;

Overload: 1.2 times full scale pressure;

Pressure type: gauge pressure or absolute pressure or differential pressure, etc.

Accuracy: ± 0.1% FS; ± 0.2% FS;

Long-term stability: ± 0.1% FS / year;

Zero Drift: ± 0.1% FS;

Output signal: (0 ~ 200) mV;

Power supply: constant current 1mA.

5 Quick Start

5.1 Basic Structure Chart (fig 5.1/5.2)

5.2 Standard Configuration

Normal pressure range selection sheet

Pressure range	Accuracy ①	Accuracy ②	Accuracy ③	Media
(-100 ~ 0)kPa	0.02, G	0.05, G	--	④
(0 ~ 16)kPa	--	0.05, G	--	④
(0 ~ 25)kPa	--	0.05, G	--	④
(0 ~ 40)kPa	0.02, G	0.05, G	--	④
(0 ~ 60)kPa	0.02, G	0.05, G	0.2, A	④
(0 ~ 100)kPa	0.02, G	0.05, G	0.2, A	④
(0 ~ 160)kPa	0.02, G	0.05, G	0.1, A	④
(0 ~ 250)kPa	0.02, G	0.05, G	0.1, A	④
(0 ~ 400)kPa	0.02, G	0.05, G	0.1, A	⑤
(0 ~ 600)kPa	0.02, G	0.05, G	0.1, A	⑤

(0 ~ 1)MPa	0.02, G	0.05, G	0.1, A	⑤
(0 ~ 1.6)MPa	0.02, G	0.05, G	0.1, A	⑤
(0 ~ 2.5)MPa	0.02, G	0.05, G	0.1, A	⑤
(0 ~ 4)MPa	0.02, G	0.05, G	0.1, A	⑤
(0 ~ 6)MPa	0.02, G	0.05, G	0.1, A	⑤
(0 ~ 10)MPa	0.02, SG	0.05, SG	0.1, A	⑤
(0 ~ 16)MPa	0.02, SG	0.05, SG	0.1, A	⑤
(0 ~ 25)MPa	0.02, SG	0.05, SG	0.1, A	⑤
(0 ~ 40)MPa	0.02, SG	0.05, SG	0.1, A	⑤
(0 ~ 60)MPa	0.02, SG	0.05, SG	0.1, A	⑤
(0 ~ 100)MPa	--	0.1, SG	--	⑤
(0 ~ 160)MPa	--	0.1, SG	--	⑤
(0 ~ 250)MPa	--	0.1, SG	--	⑤

Differential pressure range selection sheet

Pressure range	Accuracy ①	Accuracy ②	Accuracy ③	Media
(0 ~ 60)Pa	--	--	--	④
(0 ~ 100)Pa	--	--	--	④
(0 ~ 250)Pa	1.0,D	--	--	④
(0 ~ 1)kPa	0.5,D	--	--	④
(0 ~ 2)kPa	0.2,D	--	--	④
(0 ~ 2.5)kP	0.2,D	--	--	④
(0 ~ 5)kPa	0.1,D	--	--	④
(0 ~ 6)kPa	0.1,D	--	--	④
(0 ~ 10)kPa	0.05,D	--	--	④

Compound pressure range selection sheet

Pressure range	Accuracy ①	Accuracy ②	Accuracy ③	Media
±60Pa	--	--	--	④
±250Pa	--	--	--	④
±1kPa	1.0,G	--	--	④
±2kPa	0.5,G	--	--	④
±2.5kPa	0.5,G	--	--	④
±5kPa	0.05,G	--	--	④
±10kPa	0.05,G	--	--	④
±16kPa	0.05,G	--	--	④
±20kPa	0.05,G	--	--	④
±40kPa	0.02,G	0.05,G	--	④

±60kPa	0.02,G	0.05,G	--	④
(-100 ~ 60)kPa	0.02,G	0.05,G	--	④
(-100 ~ 100)kPa	0.02,G	0.05,G	--	④
(-100 ~ 160)kPa	0.02,G	0.05,G	--	④
(-100 ~ 250)kPa	0.02,G	0.05,G	--	④
(-0.1 ~ 0.6)MPa	0.02,G	0.05,G	--	④
(-0.1 ~ 1.0)MPa	0.02,G	0.05,G	--	⑤
(-0.1 ~ 2.5)MPa	0.02,G	0.05,G	--	⑤
(-0.1 ~ 4)MPa	0.02,G	0.05,G	--	⑤
(-0.1 ~ 6)MPa	0.02,G	0.05,SG	--	⑤
(-0.1 ~ 25)MPa	0.02,G	0.05,SG	--	⑤

G=gauge pressure; SG=seal gauge pressure; A=absolute pressure ; D=differential pressure ; temperature range : ①(20±5)℃,②、③(15～30)℃; ④ incorrosive gas; ⑤incorrosive liquid or gas.

5.3 Function and Service Conditions

5.3.1 Main Function and Features

1. Liquid crystal display: Multiple projects measurement and display at the same time;
2. lithium batteries (micro-power technology);
3. Pressure measurement: a single sensor configuration;

   Pressure range: (-0.1~250) MPa (Optional);

   Accuracy: ±0.05%FS; ±0.02%FS (some pressure range);
4. Current measurement:

   Measure range: (-30.00～30.00) mA;

   MPE: ± (0.01%RD+0.003%FS);
5. Voltage measurement:

   Measure range: (-30.00～30.00)V;

   MPE: ± (0.01%RD+0.003%FS);

6. Pressure switch-off measurements (if with electric，voltage range 1V~12V);
7. Temperature measurement:

   Measure range: (0~50:℃;

   Error: ±1℃;
8. Real-time clock;
9. Data storage, can store 10 files, each with 40 sets of data records;
10. RS232 communication interface with the computer (requires SPMK pressure calibration software support).

5.3.2 Additional Function

1. Pressure displayed as a percentage;
2. Pressure leak;
3. Pressure switches a variety of trigger, if the voltage switches with inspection;
4. The peak pressure recorded;
5. DC24V ± 0.5V / 50mA output.
6. HART interface

5.3.3 Service Condition

1. temperature（-10~50）℃（for work accuracy）;
2. calibration temperature：(20±2)℃;
3. relative humidity<95%;
4. Atmospheric pressure (86~101)kPa.

5.4 Power

5.4.1 Battery Usage

SPMK223 with removable 7.4V lithium-ion battery, when the battery power is low, the meter flashes, and repeatedly restart, please replace the battery or using a dedicated adapter (DC10V / 2 A) to charge, first time of charging should be no less than 12 hours, usually 3-4 hours later, 24V load; in mode of continuous backlight, battery discharge time is usually 40 hours.

5.4.2 24V Power Output

SPMK223 has function of a 24V power output, 10 minutes, 30 minutes, 60 minutes, and longtime-output as option, when the gauge output 24V power supply, 24V indicator lights, which can provide DC24V / 50mA output for under calibrated instruments, It is very convenient.

5.4.3 Recharge

This instrument provides AC and DC power supply. For AC work, please use our special adapter. If AC, it can switches into AC power automatically, then the backlight turn on, the instrument is charging, the battery icon is flashing, if the battery is fully charged, the battery charge icon flashes move together. In shutdown mode, it only display battery level icon when charging, backlight turns on, after pulling charger battery icon disappears, the backlight is off, power down into shutdown mode.

5.5 Keys Introduction

5.5.1 Keys Function

This instrument provides a number of functional keys, without difficult work , you can be completed pressures cleared, electrical logging cleared, pressure unit switching, electrical logging type switch, switch the backlight, switch 24V power output, current file storage, the current file send and other functions. Detail introduction as follows:

Keys	Function	Note
	Turn on/off	
	Pressure units switch	

	Electric logging switch	
	Pressure data clear	
	Current/voltage data clear	
	Data storage, move left cursor	
	Turn on/off 24V output, data add 1.	
	Enter/exit menu, cancel the input data	
	Enter menu/enter.	
	Turn on/off backlight, move right cursor	
	Menu page turning, data minus 1	

5.5.2 Menu Operation

SPMK223 enter and exit the menu operation is very simple and convenient, in the measurement mode only need to repeat the key  ; when you press the key  will enter the menu option mode, to exit the menu options, then press the button  to exit the menu mode and return to the measurement mode; after enter the menu option mode, use  and  to choose submenu, press  to enter sub menu you choose ,If want to exit sub menu ,press  to exit ,If there is still a sub file of choose menu, t hen press  to enter , press  to exit

All functions menu, uses Segment LCD, the specific font display function also needs to refer to the menu tree as following:

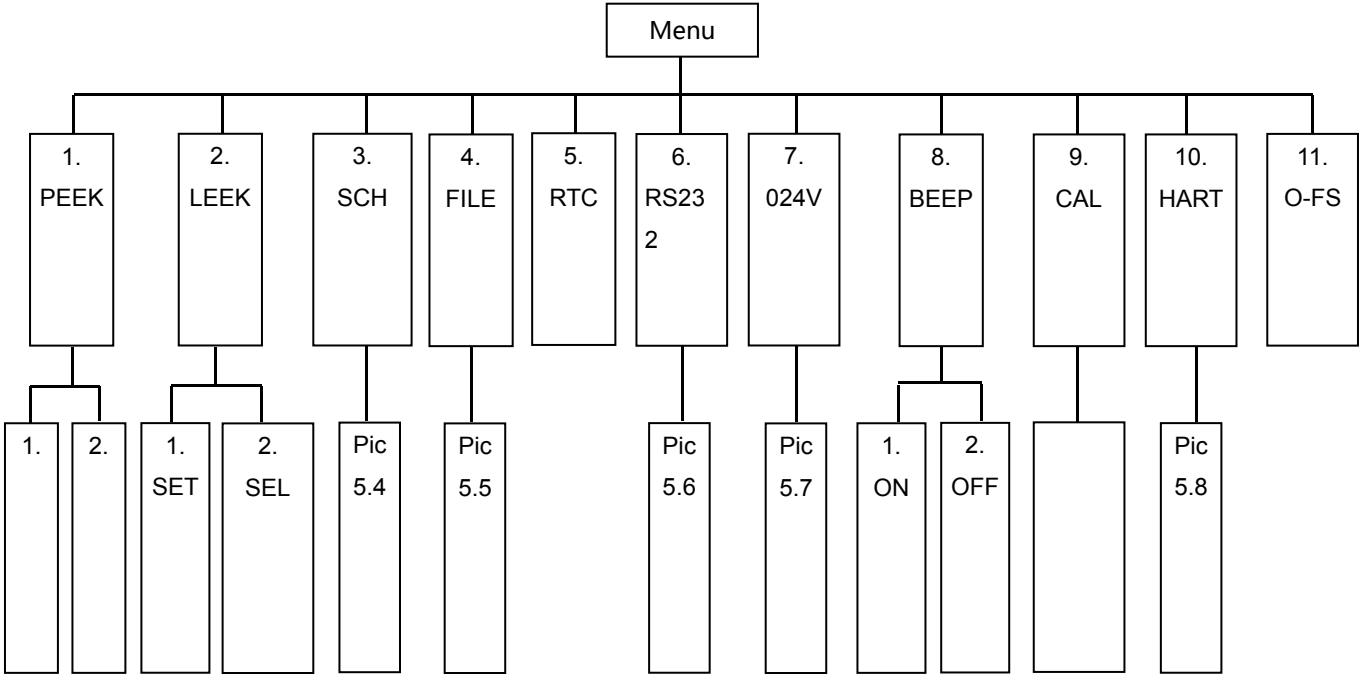

Menu
1. PEEK
2. LEEK
3. SCH
4. FILE
5. RTC
6. RS232
7. 024V
8. BEEP
9. CAL
10. HART
11. O-FS
1.
2.
1. SET
2. SEL
Pic 5.4
Pic 5.5
Pic 5.6
Pic 5.7
1. ON
2. OFF
Pic 5.8

Fig.5.3

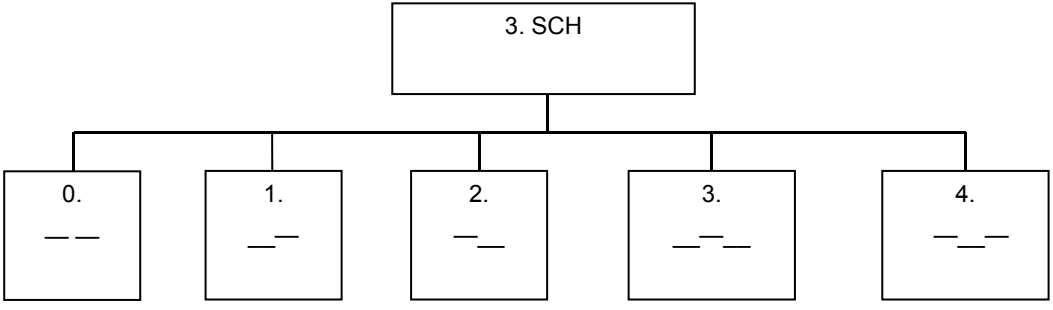


Fig.5.4

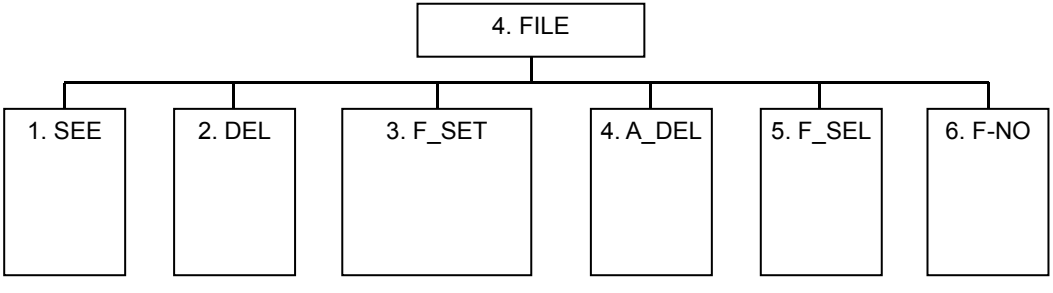


Fig.5.5

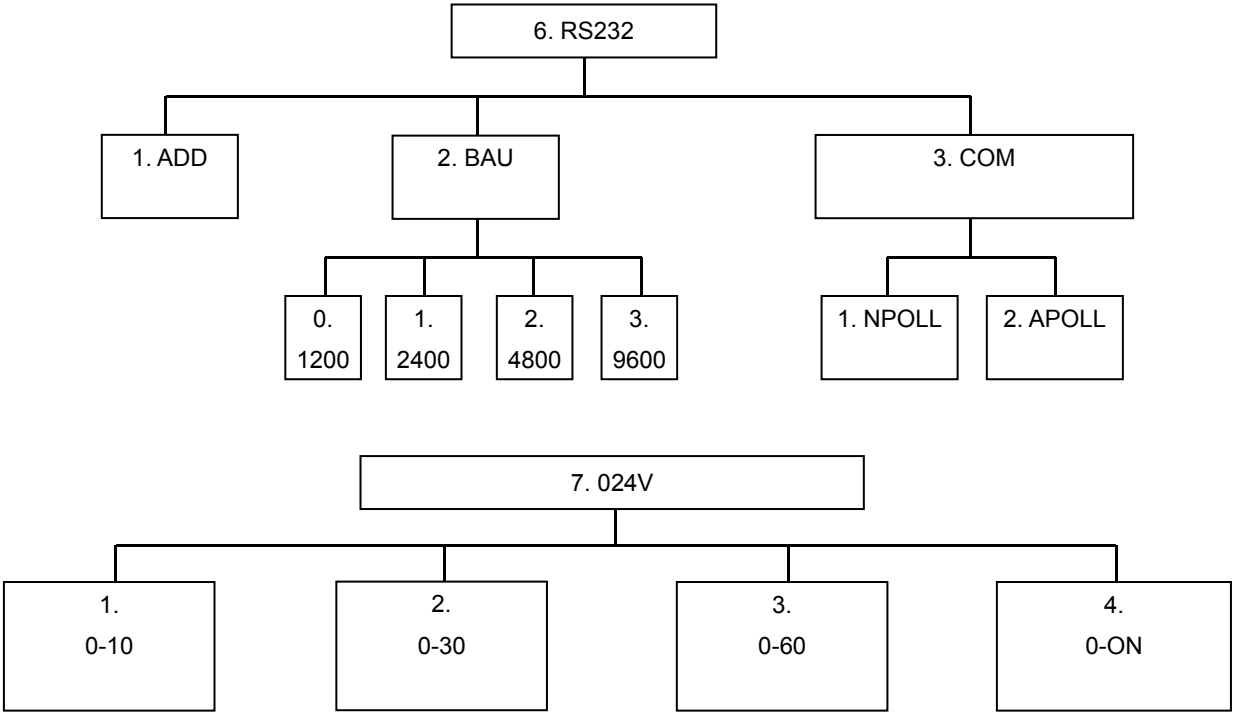

6. RS232
1. ADD
2. BAU
3. COM
0. 1200
1. 2400
2. 4800
3. 9600
1. NPOLL
2. APOLL
7. 024V
1. 0-10
2. 0-30
3. 0-60
4. 0-ON

Fig.5.7

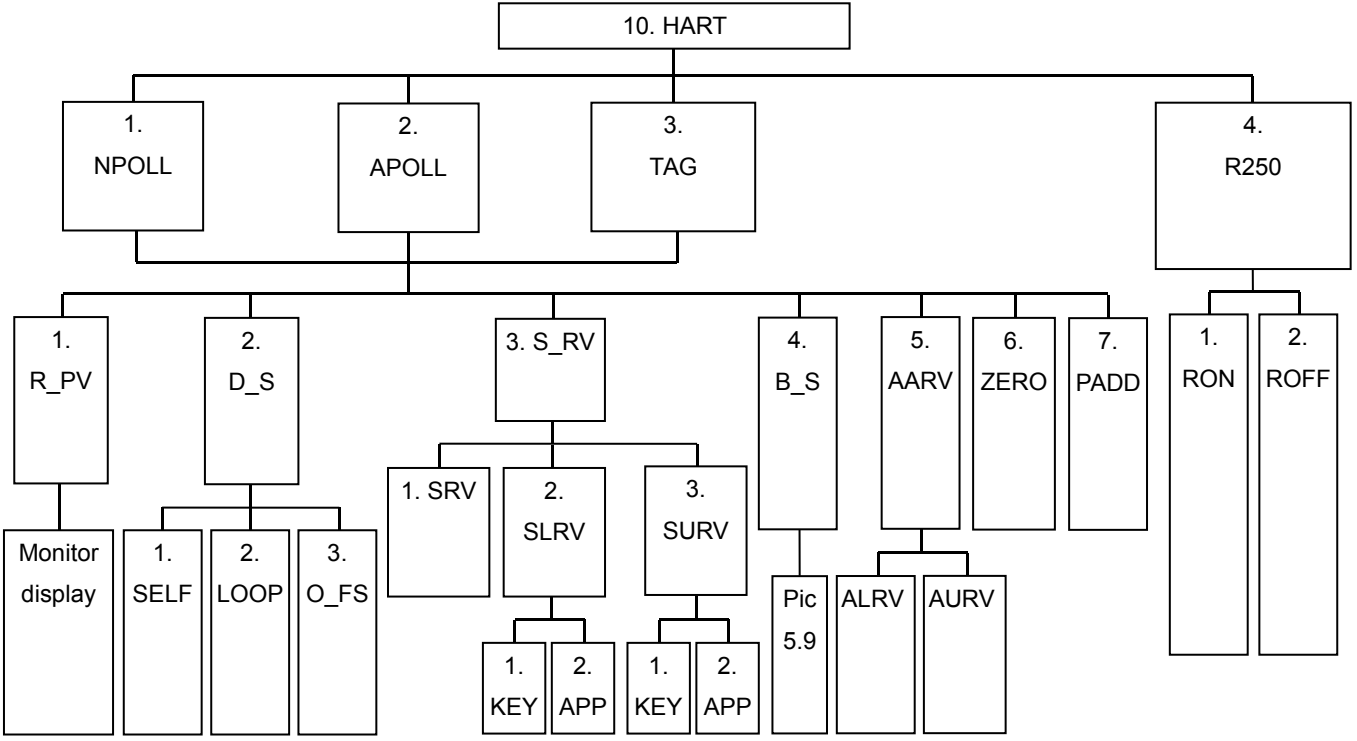

10. HART
1. NPOLL
2. APOLL
3. TAG
4. R250
1. R_PV
2. D_S
3. S_RV
4. B_S
5. AARV
6. ZERO
7. PADD
1. RON
2. ROFF
Monitor display
1. SELF
2. LOOP
3. O_FS
1. SRV
2. SLRV
3. SURV
1. KEY
2. APP
1. KEY
2. APP
Pic 5.9
ALRV
AURV

Fig.5.8

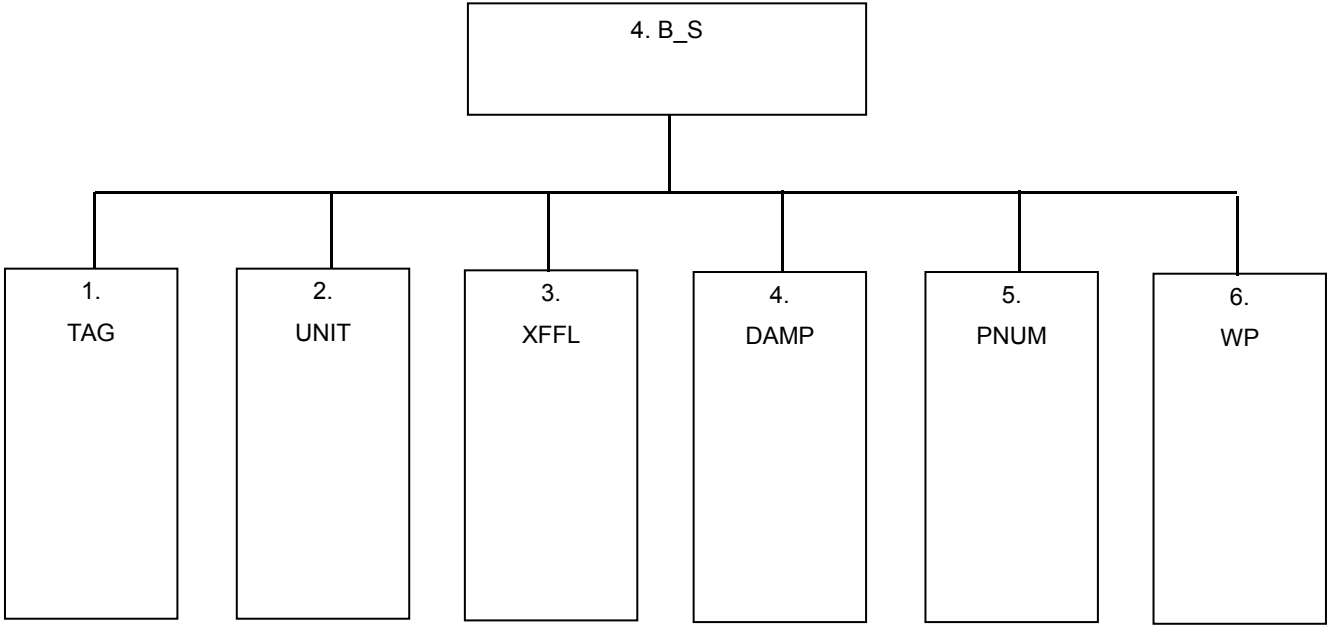


Fig. 5.9

6 Basic Operation

6.1 Turn on/off

Press  to turn on/off. When turned on, the screen displays the pressure range and then enters the main measurement interface.

6.2 Pressure Measuring Function

1. **Pressure unit switch**

Press  to change pressure unit , note : For different range, power-on default values are different; the user can switch according to their needs, please check the following:

mmH2O	mmHg	mbar	bar	psi	Pa	MPa	kPa	inHg	inH2O	kgf/cm2
101.9716 2	7.5006 2	10	0.01	0.145037 7	1000	0.00 1	1	0.295 3	4.0146 3	0.01019 7

2. **Pressure value clearing**

Gauge pressure: connect with air, if the current pressure is between(-1%~1%)FS, press 

to do zero clear of zero drift.

Absolut pressure: Strictly speaking, absolute pressure gauge no need do zero clear ,but for improve measurement accuracy, can be re-given the current atmospheric pressure, it must be noted that the current atmospheric pressure measurement of the barometer measurement accuracy must be higher than the calibration instrument measurement accuracy. After connect air, press 

, input current air pressure, return to measurement interface, at this time the measure value is same as current air pressure, we consider that we finish zero clearing. Process as following: Actual measure value is 

, current standard air is 100.00kPa, press 

, the first dig ‘8’ flash, input standard air pressure 

, press 
, at this time both of the measure value and the current air pressure are 100.00kPa.

3. **Display the cursor of pressure percentage**

In the main measurement interface, for example, the pressure range of gauge is (0 ~ 2) MPa, the current measured value is 1MPa, and then the reading area shows 50%, cursor shows 50%.

4. **Peak record of the pressure measurement value**

The gauge will record the maximum and minimum pressure in the measurement process automatically; the peak can be cleared by the user. Procedure of clear the peak: enter the basic menu,  , the maximum and minimum pressure value will be indicated on the screen, and if the user wants to re-start peak-recording, press  , he maximum and minimum values will be changed into the current measurement value automatically.

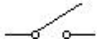
5. Pressure leak detection

Users can record the value of the pressure in the beginning and the end over a period of time. The basic steps are as following: enter the basic function menu, select 2 LEEK, enter the leak detection menu, select the first  , the first set the time of leak detection, which is expressed in seconds, you can set the maximum time of 999,999 seconds, if the user set up 80 seconds, press  to exit the time-setting menu, select the second  , you can do pressure leak detection, press  to start,  Appears on the screen, the pointer kept turning which is 80 seconds countdown, electric measuring column shows the value of the initial pressure, when the time stop,  stop turning, then there is a pressure value at the end which be

recorded by pressure column. Press  to exit pressure leak detection, leak detection icon  disappear ; if you need to do pressure leak detection again, press  .

6.3 Electrical Measure Function

1. **Electrical logging switch**

Each time you press the key  , electrical logging project switch, switch order: Current measurement, voltage measurement, switches measurement. Current unit is mA, voltage unit is V, the switch has no units but it only shows  , there are two state of  and  .

2. **Electrical logging zero clear**

In the current or voltage measurement condition, if the measurement value in the + 0.05%FS range, you can reset the measurement values.

3. **Switch measure setting**

Enter the basic function menu mode  , switch measurement has five types, which can be selected via the basic function menu.  Means no trigger mode, the screen only displays the switch status, no pressure measurement value locked. When the switch state changes the buzzer sounds;

 Means trigger from off to on, buzzer sounds in the time of trigger and put pressure measurement value lock, you can press  to restart the switch detection;

 Means trigger from on to off, same operation as above;

 Means trigger from off to on to off, buzzer sounds in the time of trigger and put pressure measurement value lock, press  then trigger from on to off, buzzer sounds in the time of trigger and put pressure measurement value lock;

 Means trigger from on to off to on, same operation as above.

Note that the switch can be electrified, the DC voltage range is (1 ~ 12) V, please distinguish between positive and negative

pole at the time of measurement, then reverse switch does not work. The switch is triggered, buzzer ring.

6.4 DC24V Power Output Function

1. **DC24V turn on / off**

In the main measurement interface, press 

,open the 24V output, at the same time, the appearance of the screen icon 

,press 

again , 

disappear , DC24V output is shut down. Close the DC24V can effectively prolong the life time of the battery.

2. **DC24V output timer**

Enter the basic functions of the menu 

, the output of the DC24V is divided into 4 kinds: 10 minutes, 30 minutes, 60 minutes and always opened. When select 

, DC24V be opened until the user press 

to close. If you choose the 30 minutes, then since DC24V start opening to start timing, after 30 minutes, DC24V automatically shut down. This feature is to prevent users forget to turn off the DC24V output, which will affect the time of battery power supply.

Note: Due to the existence of precision components of the error, the timing error ± 10S.

6.5 Backlight Turn On/Off

In the main measurement interface, press  , you can turn on or off the display backlight; display backlight is blue / white.

6.6 The Buzzer Open or Closed

Enter the basic functions menu  , then select  or  , o open or close the buzzer. Buzzer sound under the following circumstances:

1) Key response, correct execution, makes a sound;

2) The instrument plug adapter, make a sound;

3) Battery power down sounds twice;

4) Instrument turn on, sounds twice;

5) Switch measurement mode, the trigger switch or a change in state, a buzzer sounds.

6.7 Instrument Clock

Enter the basic functions of the menu  , he time display area figures began to flicker, which remind the user to adjust the time, time display area of display format: 20XX year /XX month XX day XX minute /XX, XX for the adjustment of digital, from (0 to 9), out of bounds automatically return 0;

 or  are left / right key ,  adjust the keys for the number.

6.8 Communication Function

1. RS232 serial port setting

The communication interfaces of this gauge is RS232, users can connect with computer via a standard RS232 cable. It has two settings, instrument address and baud rate. Enter the basic menu  , the address range (1 to 112), selectable baud rate: 1200,2400,4800,9600.

2. Connect pressure calibration software

The instrument is connected to the pressure calibration software via the serial port, and the measurement data under each file number can be uploaded to the computer.

3. Connect with SPMK2000T auto pressure calibration bench:

The instrument is connected to the pressure calibration software via the serial port, and the measurement data under each file number can be uploaded to the computer.

6.9 File

6.9.1 File Storage

This instrument provides powerful storage capabilities, a total of 40 files, each file can store 40 sets of data, each data has a time stamp, it is convenient of data analysis for users. The data storage can be checked, delete and export, following is a full introduction of the stored procedures: Under the File menu state, each time the storage meter will automatically store a set of measurement data, when the file number over 40 sets of data storage, then the buzzer rang three times, you need to change the file number or delete the content under this file. If you press  for a long time, it will exit the file operation mode.

6.9.2 Enter File Menu

Enter through the basic functions menu  ;

Note: To operate on the contents of the file, enter the file unction mode  showing  otherwise the file

operations is invalid; after entering the file function mode, the percentage of the pressure automatically switch to the percentage of storage numbers, the left column of temperature shows the current file number, the middle scale bar shows the percentage of the number of current storage document, the right content shows the number of current stored document in this file.

6.9.3 Set File Attributes

There are two file attributes: number of under-calibrate gauge is CODE, minimum scale SCALE, enter menu of 4. FILE , select 3F_SEt , first you will be asked to enter number of under-calibrate gauge , a total of six digits, after the completion of data entry  , the screen is then asked to enter the minimum scale value, press  to adjust the decimal point then save by press  That is the file attributes procedure.

6.9.4 Choose File Number

Through the basic functions menu, enter file settings menu 4. FILE , then select 6. F_NO by  or  button to adjust the current file number, file number in the range (1 to 40).

6.9.5 Operation Content of File

After selecting the file number, enter the file operation content selection menu, the contents of the file is as following：

1. View file content

Under File Mode, enter into the File menu  , select  press  to display the file, first shows the file attributes, then press  or  to select the display each set of measurement data, press  or  to select the contents of each data store until the last set of saved data, press  to return to file menu.

2. Delete file content

In the file mode state, enter file menu  ,select  ,press  to delete the file under this number.

3.  Set file attributes.

4.  delete the file of (1 ~ 10).

5.  Turn on/off the file mode.

6.  Select file number.

6.10 Instrument Calibration Function

This function is used to correct for measurement precision, when the instrument cycle test, if there are deviations of the precision of instrument, the instrument can be calibrated, the calibration must control by professional person. Instrument calibration is preferably to be operated with power, and ensure that warm up for 30 minutes or more, at the time of calibration, the pressure should be pressurized to full scale, then directly reduced to 0, and the repeat this procedure for 3 times to make it into the best condition before calibration. If the instrument has been calibrated by mistake, you can restore the factory settings.

Note: Calibration must be done when it meet the calibration conditions!

6.10.1 Calibration Condition

1. Environmental conditions meet requirements for transfer:

   Ambient temperature: (20±2) ℃;

   Relative humidity: (45 ~ 75) %;

   Atmospheric pressure: (86 ~ 101)kPa, avoid external electromagnetic interference.

2. Comply with the standard equipment of value transfer.

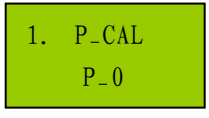
6.10.2 Enter Calibration Menu

Enter through the basic function menu 

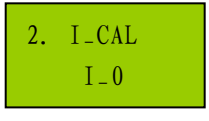
.

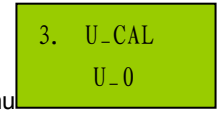
6.10.3 Content of Calibration Menu

1. Pressure calibration menu



2. Current calibration menu



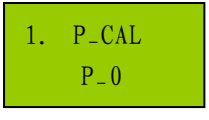
3. Voltage calibration menu 

Note: '0' means no pressure calibration has been done , '1' means pressure calibration has been done. When shows '1',

press  to cancel the calibration , then shows from '1' to '0' . Same for 2 and 3, but for electric current and voltage measurement.

6.10.4 Calibration of Pressure Measurement

Choose zero and full range value in signal pressure range of sensor, in composite range is negative full range value, zero and positive full range value, users can choose calibration value by the key of  or  to do the calibration. After calibration press  to exit the menu, the calibration mark changed from 0 to 1.

We make an example of (0 ~ 60) Mpa: zero and full range 60 MPa to do calibration, the pressure calibration process as following: 

1. Select calibration menu to enter the pressure calibration mode.
2. Make sure the gauge is with the atmosphere, screen shows pressure measurement value after calibration. the screen flashes shows 0Mpa of the point of 0, it enter the main interface automatically pressure column to show the pressure

measurements, press  when pressure value is stable, then complete the calibration at this point. The user can press ( or ) button to change into 60MPa calibration point, the screen shows standard pressure of 60MPa,then adjust the standard gauge into 60MPa, press  , when pressure value is stable, the main interface pressure measurements change into 60.000 MPa, then complete calibration of the instrument;

3. Compound pressure calibration is the same as a single pressure calibration, as only increased the maximum negative pressure calibration points;

4. If you had calibration with mistake, and get a incorrect measurement values, the user can press  to cancel the calibration in state of P_1, the calibration status mark come back to the state of P_ 0, that is restored to factory reset.

6.10.5 Calibration of Current Measurement

Operation of current calibration is the same as operation of pressure calibration. Current calibration source is current source. Current calibration is 3 point calibration, the default point is -30mA, 0mA, 30mA. If the user made a wrong calibration, which makes the measurement data incorrect, then the user can press  in the I_1 state to cancel the calibration. Calibration

status flag is returned to the I_0 state, which means restore to factory condition.

6.10.6 Calibration of Voltage Measurement

Operation of voltage calibration is the same as operation of pressure calibration. Voltage calibration source is voltage source. Voltage calibration is 3 point calibration, the default point is -30V, 0V, 30V. If the user made a wrong calibration, which makes the measurement data incorrect, then the user can press 

in the V_1 state to cancel the calibration. Calibration status flag is returned to the V_0 state, which means restore to factory condition.

Note:  representation state of measurement to factory settings ,  represents the user has done calibration. If the display shows  , press the button 

to cancel the calibration.

6.10.7 Zero Clearing

Temperature, altitude and other environmental factors can affect the accuracy of sensor. zero clearing function is the effective measures to solve these external factors, and this function does not influence the accuracy of instrument.

1. Pressure zero clearing

The sensor is connected with the external air, if the zero shifts; whether it is caused by the location factors or temperature

factors press 

to complete the zero shifts, please see 6.2.2.

2. Electric logging clearing

If the electrical measurement mode is in a voltage or current measurement mode, removed the voltage source or current source, press the button 

that completed the electrical measuring zero shift.

Note: the zero clearing of electric measuring and pressure must be operated within the range, otherwise the operation is invalid.

6.10.8 Restore Factory Settings

After pressure 
, via 
or 

to choose 

to enter the factory settings function , press 
all settings user information is completely empty, return to the status of factory setting.

6.11 HART Function Introduction

HART (Highway Addressable Remote Transducer) is Communication protocol, is a communication protocol used between the field intelligent instruments and control room equipment, produced by the United States ROSEMOUNT company in 1985. HART device provided with a relatively low bandwidth, moderate response time communication, after 10 years development,

HART technology is very mature in foreign countries, and has become the industry standard of intelligent gauge in the world. HART protocol standard based Bell202 Frequency Shift Keying FSK signal on (4 ~ 20) mA analog signal superimposed low-frequency amplitude of audio digital signal 0.5mA of two-way digital communication, data transfer rate of 1.2Mbps. Since the average value of the FSK signal is 0, does not affect the size of the analog signal transmitted to the control system, to ensure compatibility with existing analog systems. The main variables and control information (4 ~ 20) mA HART protocol communication transmitted, in case of need, additional measurements, process parameters, device configuration, calibration, diagnostic information via HART protocol access. The HART protocol of intelligent transmitter has the features of digital signal and (4~20) mA control signals transmit simultaneously without mutual interference, which makes the control and intelligent communication work at the same time, which is very convenience and safe. Other communication protocols cannot do this. SPMK223 With standard HART communication protocol and HART manipulator function, which can calibrate or configuration settings of the HART , It can replace ROSEMOUNT type275 handheld HART communication device to do calibration of intelligent transmitter. It can calibrate or configuration settings of the HART type intelligent pressure transmitter, it is convenient for user to do calibration of HART type intelligent pressure transmitter.

6.11.1 HART Menu Operation

Press 

to open 24V inner electric source or open outside 24V power, after transmitter working well, press  to

enter function menu, press  or  to switch into menu of  , press  , there are four sub menu of HART, To properly communicate and configure the transmitter, the four function submenus must be selected and set correctly.

1. **NPOLL(Single point communication)**

Select to communicate with transmitter single point of communication, first of all to know the transmitter's communication address, under menu  press  , shows  , use  or  to change value, use  or  to shift, after changing press  . If the communication address is correct, you can enter HART function sub-menu, if not correct, it will exit automatically.

2. **APOLL (Multipoint polling)**

Select to communicate with transmit multi-point communication, SPMK223 according to the transmitter polling address range 0 ~ 15, automatically search the transmitter, if you search that there is transmitter working, you can enter the HART function submenu, Otherwise it will automatically exit.

3. **TAG (Station number addressing)**

Select to transmitter station number addressing, first of all to know the transmitter station number, under menu of 

and press  , after showing  , use  or  to change value, use  or  to shift, after changing pressure  . If the station number is correct, you can enter the HART function submenu, Otherwise it will automatically exit.

4. R250 (Internal or external communication sampling resistor selection)

According to the actual situation of the correct use of internal or external communication sampling resistor, under menu  and press  , if use external communication sampling resistor, choose  , then press  , if use internal communication sampling resistor, choose  ,then press  . Enter HART communication state, polling connect transmitter; after connect successfully, SPMK223 will show HART function sub-menu. You can choose the following 7 sub-menu of HART. 1. R_PV (Read variate), 2. D_S(Diagnose and Safeguard), 3. S_RV (Range) , 4. B_S (Basic setting), 5. AARV(Simulate output alarm), 6. ZERO, 7. PADD (Write polling add)

6.11.2 HART Communication and Configuration setting

1. Read master variable

Choose menu of  , press  , you can do calibration accordingly. The online menu selects the first item to enter

the process variable function. The menu contains the main variables, the output current and the percentage value, and will be updated with each communication in real time. And the process variables of each transmitter are displayed on the same screen, if the exit process variable mode, you need to press  .

2. Diagnose and safeguard

Press  , press  to enter this menu,

1) Choose  menu, press  , transmitter on line will execute self-test command;

2) Choose menu of  , press  , then show three test calibration points are as follows: Select the loop current detection, the transmitter can be fixed to output a current signal to facilitate the verification of the entire circuit is normal.

- 4.000mA
- 12.000mA
- 20.000mA

Press  or  to switching to the test calibration point option, after that press  , the transmitter enters the

loop current test or calibration mode, the transmitter operates at a 4.000mA or 20.000mA test calibration point, if you need to calibrate or adjust the loop current gain, just press 

. The operation is not available at the test point of 12.000mA.

3) Under menu of  restore the factory settings menu  , press  , The transmitter is restored to the factory's original configuration settings.

3. Range

Select  , press  to enter the menu

1) Select the read sensor range SRV menu, press  , displays the upper and lower limits of the sensor range;

2) Select range lower limits menu  , press  , shows as following:

◆  (Keyboard input)

Press  or 

shift to option of  , press  and shows  , after that

press  or  to change value, use  or  to shift , once finish changing press  .

-  (Use current pressure)

  Press  , transmitter set current pressure as range lower limit.

3) Choose range upper limit  menu. Same way as changing range lower limit, press  to exit.

4. Basic setting

Choose  , press  to enter B_S menu.

1) Choose station number menu of  , press  , shows station number; if need to change, press  , input new station number, pressure ENTER to finish changing, press  to exit. Station number is ASCII character, Comparison table as following:

ASCII码字型显示对照表											
PA	CHR	DISP	PA	CHR	DISP	PA	CHR	DISP	PA	CHR	DISP
1	空		17	0	0	33	@		49	P	P
2	!	!	18	1	1	34	A	A	50	Q	Q
3	"	"	19	2	2	35	B	B	51	R	R
4	#	#	20	3	3	36	C	C	52	S	S
5	$	$	21	4	4	37	D	D	53	T	T
6	%	%	22	5	5	38	E	E	54	U	U
7	&	&	23	6	6	39	F	F	55	V	U
8	'	'	24	7	7	40	G	G	56	W	U
9	(	(	25	8	8	41	H	H	57	X	H
10	)	)	26	9	9	42	I	I	58	Y	Y
11	*	*	27	:	:	43	J	J	59	Z	Z
12	+	+	28	;	;	44	K	K	60	[	[
13	,	,	29	<	<	45	L	L	61	\	\
14	-	-	30	=	=	46	M	M	62	]	]
15	.	.	31	>	>	47	N	N	63	^	^
16	/	/	32	?	?	48	O	O	64	-	_

2) Choose master variable menu  , press  show master variable unit, pressure key of sending or 24V to shift to necessary pressure unit, press  to confirm, press key of menu to exit.

3) Choose root or linear output function menu  . Press  show root or linear, press  to change output

function.

4) Choose output damping time function menu  . Press  displays the modified transmitter variable output update time, press  modify the transmitter variable output update time. Press  to exit

5) Select the number of entries  menu. Press  and show number of entries, press  to change. press  to exit.

5. AARV (Analog output alarm)

Choose function of write protection menu  . Press  to show write protection state, if the state is open shows  , close shows  . Press  to exit.

6. Transmitter clear

Choose  , after press  transmitter zero clear. Used to correct the pressure zero drift due to changes in the position or temperature of the transmitter.

7. Write the transmitter polling address

Choose  , press  input polling address, and then press  for update transmitter communication address.

7 SPMK223 Typical Application

7.1 SPMK223 can be used alone as a Measuring Instrument

When you use it, please connect pressure measuring port with pressure system, In order to make sure the stability of the measured pressure value, please do not use corrosive medium.

7.2 SPMK223 used as a Standard to calibrate other measuring instrument

SPMK223 pressure gauge used with manual pressure pump, which compose a high precision calibration system. It can calibrate pointer or pressure transmitter.

Pic 7.1

Pointer gauge calibration process connection (picture7.1).

Increase/decrease pressure to standard gauge and the gauge under calibration at the same time. These 2 gauges show the measured value of pressure, refer to the relevant pressure test procedures, according to the standard meter readings, and determine accuracy of calibrated gauge.

7.3 Calibration of Pressure Switch

Basic step:

1. Connect pressure switch with SPMK223 on one pressure source;
2. Press 

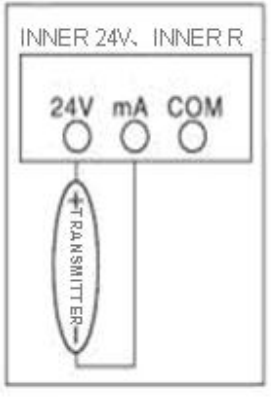
, the electrical test items to switch to switch measurement; If you want to do the trigger mode switch measurement, then enter the menu to select the trigger mode;
3. According to the requirements of the pressure switch test procedures, take SPMK223 as a standard to calibrate the pressure switch. According to the measured pressure value of SPMK223 and the gauge be calibrated to determine the accuracy of the under calibrated gauge.

7.4 Calibration Method of Pressure Transmitter without HART

Basic step:

1. Connect the pressure indicator and SPMK223 with a pressure pump, Connect SPMK223 the 24V output terminal with transmitter "+" port by the red lead wire, Connect SPMK223 mA input terminal with transmitter "-" port by the black lead wire, connection as following (picture7.2 / 7.3)

Picture 7.2



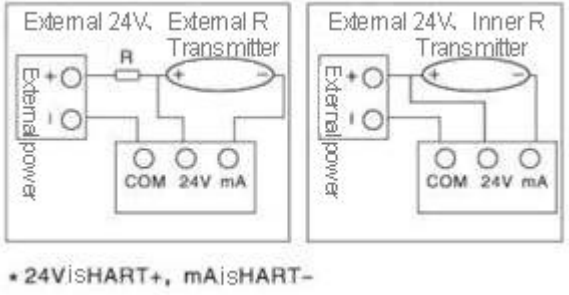
Picture 7.3

2. Press E FUN, switch electric logging into current measure; press 24V to open 24V power, at the same time, SPMK223 electric measure shows output electric signal. If you want to control time of 24v, you can choose the time period by entering menu.

3. According to requirements of pressure transmitter calibration procedure, take SPMK223 as a standard to calibrate the pressure transmitter.

7.5 Calibration Method of Pressure Transmitter with HART

1. Connect the pressure transmitter (with HART) and SPMK223 with a pressure pump, Connect SPMK223 the 24V output terminal with transmitter "+" port by the red lead wire, Connect SPMK223 mA input terminal with transmitter "-" port by the black lead wire, connection picture as following: (Pic7.4).



Picture 7.4 Picture 7.5

2. You can use the power of the SPMK223 internal 24V power as transmitter power; you can also use external power. No matter inner 24V power or external power supply, SPMK223 24V output terminals must be connected with "+" port of transmitter, because this electrical measuring port is HART signal "+" input terminal, mA input terminal is HART "-" input terminals, electrical connection diagram is as follows: (as following picture 7.5).

3. Open SPMK223, operation as following:

   1) Electric connection picture, connect HART pressure transmitter.

2) Press 

open inner 24V or outside 24V power，after transmitter works well, press  to enter functure menu, press  or 

to switch into 

menu, press  ,there are four sub menu of HART function

- NPOLL
- APOLL
- TAG
- R250

First, according to the connection chart, connect SPMK223 with pressure transmitter, correct use of internal or external communication sampling resistor, if need to open inner communication sampling resistor, under 

menu, press  , if use external communication sampling resistor, choose 

, press  ; if use internal communication sampling resistor, after choose 

, press  will be ok.

Secondly, choose single point communication with pressure transmitter 

, first you need to know the

communication address of this transmitter, under menu of  to press  , after show  ,use  or  to change value, use  or  to shift, after changing press  . If communication address correct, you can enter the HART function submenu, otherwise it will automatically exit. The polling address of the transmitter must be in the range of 0 to 15, otherwise it cannot communicate with it.

The link to the HART transmitter is successful and the SPMK223 will display the HART function submenu. You can choose the following 7 sub-menu of HART. 1. R_PV (Read variate), 2. D_S(Diagnose and Safeguard), 3. S_RV (Range) , 4. B_S (Basic setting), 5. AARV(Simulate output alarm), 6. ZERO, 7. PADD (Write polling add), press  to enter the relevant submenu.

3) Fixed output loop current or calibration AO output value

To test fixed output loop current or calibration AO output value, choose menu of  , press  and show test calibration 0 point as following:

- 4.000mA

Press  or 

to the test calibration point option, press  , The transmitter enters the loop current calibration mode, the transmitter operates at a 4.000mA or 20.000mA test calibration point if calibration or adjustment of the loop current gain, press 

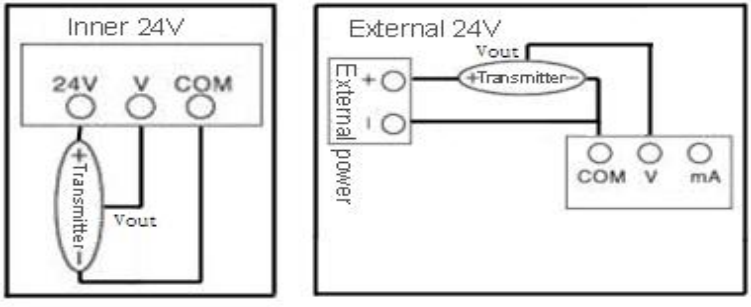
to finish calibration operation.

4. According to the requirements of the pressure transmitter verification procedure, SPMK223 is used as the standard table to check the pressure transmitter. According to the standard table and the pressure measurement data of the test table, the error of the pressure transmitter is determined.

7.6 SPMK223 Voltage type pressure transmitter calibration method

Three-wore system pressure transmitter calibration method:

1. Taking the internal 24V as an example, the pressure transmitter and SPMK223 are connected to the same pressure pump. The "24V" output terminal of the SPMK223 is connected with the "+" terminal of the transmitter with the red lead wire and the "COM" input terminal of the SPMK223 The black wristwatch is connected to the transmitter "-" terminal, and the "V" input terminal of the SPMK223 is connected to the transmitter signal output terminal "Vout" with a stylus cable, the electrical connection (picture7.6.0). External 24V power supply when referring to the right picture.



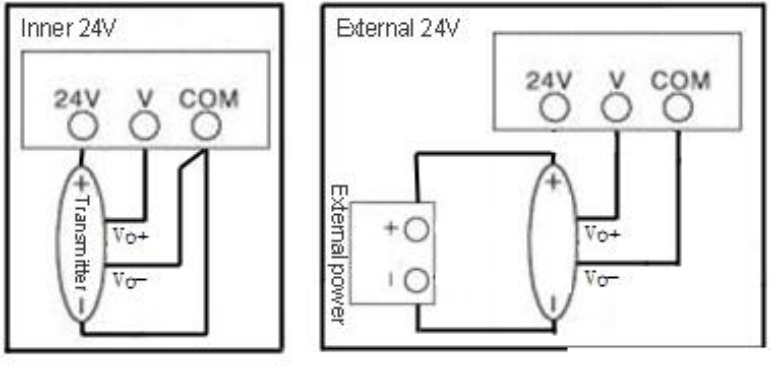
Picture 7.6.0

2. Press E FUN, switch the electrical test to the voltage measurement; press 24V to open 24V, At this point, SPMK223 of the electrical display shows the transmitter output voltage signal. If you want to control the 24V duration, then enter the menu to select the appropriate time period.

3. Press the pressure transmitter verification procedures to SPMK223 as a standard table to verify the pressure transmitter.

Calibration Method of Four - wire Voltage - type Pressure Transmitter:

1. Taking the internal 24V as an example, the pressure transmitter and SPMK223 are connected to the same pressure pump. The "24V" output terminal of the SPMK223 is connected with the "+" terminal of the transmitter with the red lead wire and the "COM" input terminal of the SPMK223 The black wristwatch is connected to the transmitter "V o-" and the power "-" terminal. The "V" input terminal of the SPMK223 is connected to the transmitter signal output terminal "V o +" with a stylus cable (connection picture 7.6.1). External 24V power supply when referring to the right picture.



Picture 7.6.1

2 . Press 

, Switch the electrical test to the voltage measurement; press 

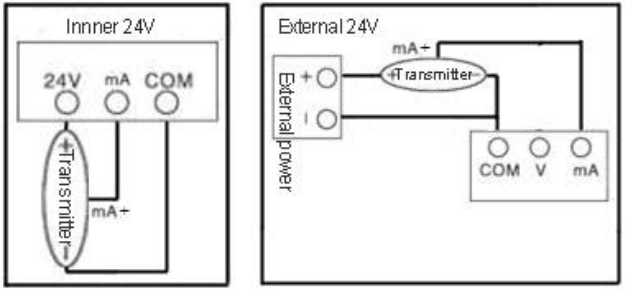
to open 24V, at this time, The SPMK223's electrical display bar shows the output voltage signal of the transmitter. If you want to control the 24V duration, then enter the menu to select the appropriate time period.

3 . Press the pressure transmitter verification procedures to SPMK223 as a standard table to verify the pressure transmitter.

7.7 SPMK223 calibration method of Current - Mode Pressure Transmitter

Calibration Method of Three - wire Current - Mode Pressure Transmitter :

1. Taking the internal 24V as an example, the pressure transmitter and SPMK223 are connected to the same pressure pump. The "24V" output terminal of the SPMK223 is connected with the "+" terminal of the transmitter with the red lead wire and the "COM" input terminal of the SPMK223 The "mA" input terminal of the SPMK223 is connected to the transmitter signal output terminal "mA +" with the stylus cable, and the electrical connection(picture7.7.0). External 24V power refer to right picture.



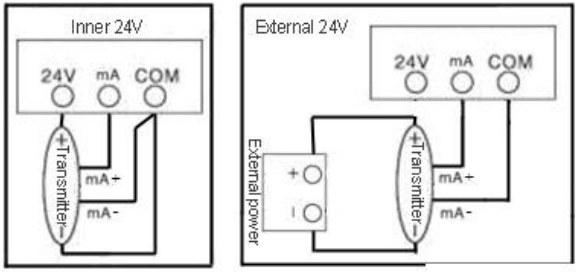
Picture 7.7.0

2. Press  , switch the electrical test to the current measurement; press  to open 24V power, At this point, SPMK223 of the electrical display shows the transmitter output current signal. If you want to control the 24V duration, then enter the menu to select the appropriate time period.

3. According to the pressure transmitter calibration procedures to SPMK223 as a standard to calibrate the pressure transmitter.

Calibration Method of Four - wire Current - Mode Pressure Transmitter:

1. Taking the internal 24V as an example, the pressure transmitter and SPMK223 are connected to the same pressure pump. The "24V" output terminal of the SPMK223 is connected with the "+" terminal of the transmitter with the red lead wire and the "COM" input terminal of the SPMK223 The "mA" input terminal of SPMK223 is connected with the transmitter signal output terminal "mA +" with the stylus line, the electrical connection (picture 7.7.1). External 24V power refer to right picture.



Picture 7.7.1

2. Press  , switch the electrical test to the current measurement; press  to open 24V power, at this time, The SPMK223's electrical display bar shows the output current signal of the transmitter. If you want to control the 24V duration, then enter the menu to select the appropriate time period.

3. According to the pressure transmitter calibration procedures to SPMK223 as a standard to calibrate the pressure transmitter.

7.8 Usage of SPMK223 Differential Pressure Instrument

Differential pressure instrument has two ports, high pressure (H) and the low pressure port (L) (pressure reference port), in use, take one port as a pressure measurement port, another port as the pressure measurement reference port. In order to make the pressure measuring port value stable, the difference value of the two ports impact by the environment must be zero, the pressure reference port keep open with atmosphere (except condition of give pressure to high pressure terminal and low pressure terminal at the same time). Measuring tube must be kept clean and dry inside, water, oil and dirt and other debris are not allowed; also pay attention to the surrounding airflow, temperature and vibration and other environmental factors, which cannot change too much, otherwise it will affect the pressure measurement accuracy.

1. **Give Pressure**
   a. When give pressure to high pressure port, low pressure port (pressure reference port) hang in the air and open to the atmosphere. When give positive pressure (blowing) to high pressure port, SPMK223 shows positive value, when give negative pressure (suction) on the low pressure side, it shows negative pressure
   b. When give pressure to low pressure port, high pressure port (pressure reference port) hang in the air and open to the

atmosphere. When give negative pressure (suction) on the low pressure side, , when give to low pressure port, SPMK223 show a negative value.

c. When give positive pressure (blowing) and negative pressure (suction) to high pressure port and low pressure port at the same time. When the pressure of the two port is the same, SPMK223 shows 0, when pressure of high pressure port higher than low pressure port (pressure reference port), SPMK223 shows positive value. When pressure of high pressure port lower than low pressure port (pressure reference port), SPMK223 shows negative value.

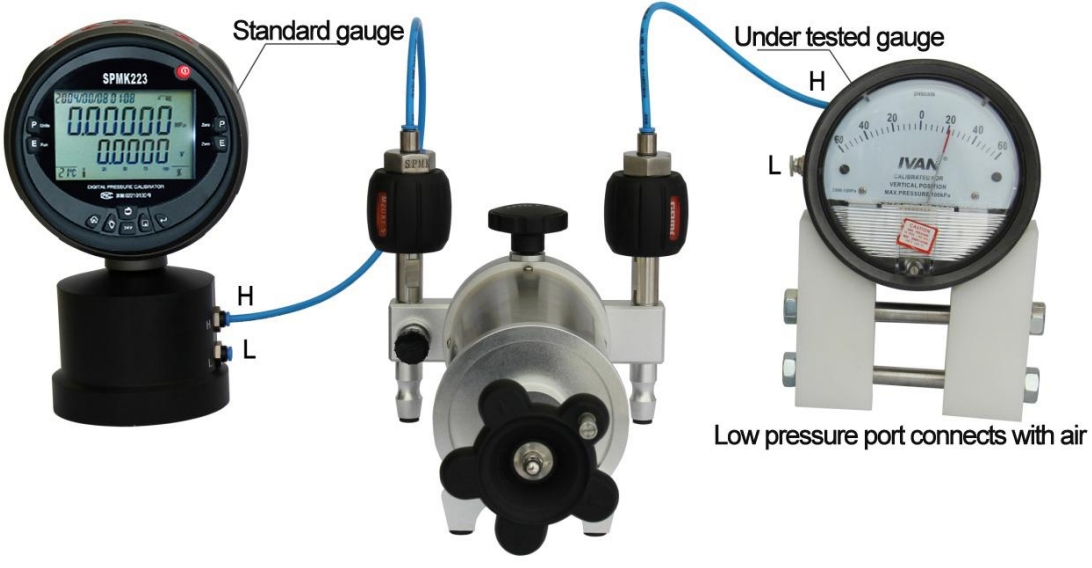
Note: Pressure on the high side or the low side must be less than two times of the instrument pressure range, differential pressure calibration refer to relevant regulation.

2. SPMK223 differential pressure gauge work with SPMK2000C manual pressure pump

It makes up a high accuracy standard micro pressure source, which can calibrate differential pressure pointer gauge and differential pressure transmitter and other instruments.

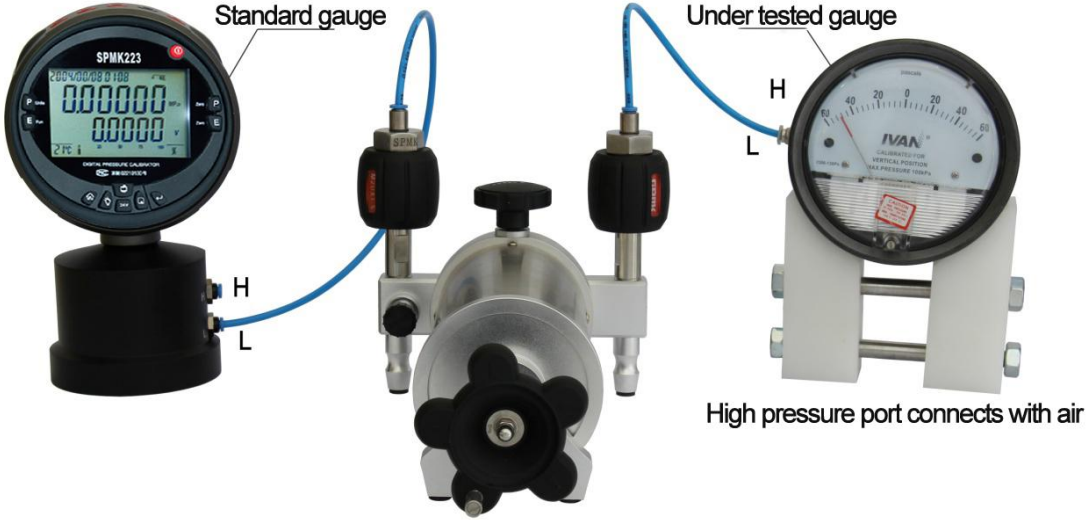
Differential pressure gauge connection as following:

a. High pressure port of under calibrated instrument connection diagram (picture 7.6)



Picture 7.6 low pressure port calibration connection

b. Low pressure port of under calibrated instrument connection diagram (picture 7.7):



Picture7.7 high pressure port calibration connection

8 Common Problem and Solutions

1. If the screen restart-mark flickers repeatedly or cannot turn on, it indicates the lack of battery power, 7.4V battery needs to be replaced; if there is no battery, you can use the AC 220V to DC10V / 2A power adapter.
2. When the user enters the pressure calibration menu, if there is mistake of calibration, you can restore the factory settings, or cancel the calibration by enter the calibration menu to format the calibration data.
3. If the pressure radix point on screen does not meet accuracy, you can press  , pressure decimal digit on the display will automatically increase or decrease a valid number, default is 0.05%FS.
4. When pressure is applied to the instrument, show no change in pressure, or show OVER indicating over the pressure range, calibrator overload, please reduce pressure within the pressure range which shows when it turns on.
5. When pressure is applied to the instrument, the pressure change is slow, please check the pressure interface if it is blocked by debris, if blocked, pressure sensor interface needs to be cleaned.
6. When take the instrument from indoors to outdoors, or indoors to outdoors, if the pressure measurement value is not accurate, please place the instruments in the current environment for one hour before use, because the pressure sensor has function of temperature compensation, it need work with temperature sensors simultaneously, in this way,

the pressure measurement can achieve the accuracy.

7. If the value of instrument display change a lot in zero pressure, please check if there is water drops or oil in pipeline.
8. Use HART function menu cannot communicate with the transmitter, firstly, please check if it is intelligent transmitters with HART protocol, common transmitter cannot use the HART communication protocol. Second, to see check if the 24V power supply is open, in the process of connection need to correctly use the communication sampling resistor, see the process connection diagram.

9 Other Notes

- Do not exceed the rated pressure. More details please check description of measuring range.
- Follow all equipment safety regulations.
- When measuring wire inserted in the current measurement side, please do not make contact with the voltage source.
- Check the housing of the instrument before use to see if there are cracks or gaps. Pay special attention to whether the insulation of the joint part of the connecting wire is complete.
- According to the requirement of measurement, choose measurement functions and range
- Before using SPMK223, please Check the battery compartment cover is locked;

- Before you open the battery compartment, please unplug wire from the SPMK223;
- Checking whether measuring wire insulation materials is damaged or is exposed metal part; please replace the damaged wire before use.
- When using the chuck of the measuring wire, do not touch the chuck metal part of the finger part
- When disassembling the calibrator, make sure the pressure conduit is closed and released when connected or removed.
- Before replacing the use of functions, please disconnect the wires.
- When do repair on SPMK223, please use the specified parts for replacement.
- When the battery is too low, please charge the battery in order to avoid adverse effects on reading.

Accessories

1. Current and voltage test line 1 set.
2. AC power adaptor 1 set.
3. (SPMK223 Intelligent Digital Pressure Calibrator User's Manual) 1 piece.

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